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Fundamental Movement Skills 'Mastery' and Habitual Physical Activity in British Primary School Children

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Abstract

Declines in physical activity (PA) and increases in obesity levels in children have prompted increasing interest in understanding children's PA behaviour. The mastery of fundamental movement skills (FMS) is a key factor in the promotion of lifelong physical activity and research has reported there is a relationship between FMS mastery and habitual PA in children. However, data are equivocal and these findings remain inconclusive. The aim of this study was to examine the relationship between FMS and habitual PA in primary school children, looking at the various correlates associated with FMS such as age, gender and weight status. Following ethics approval, parental informed consent and child assent, 264 children from years 1-6 in a West Midlands primary school volunteered for the study. Children underwent assessment of 7 FMS (sprint, side-gallop, hop, jump, catch, throw, balance) using established criteria (Booth *et a*l. 1997). Data was recorded and video clips subsequently analysed (Quintic Software, Coventry) against NSW performance criteria (New South Wales Health, 2003) to determine percentage mastery of each FMS. Correlation coefficients were used to examine the relationship between PA and FMS. A series of 2 (gender) by 6 (year group) by 2 (weight status) ANOVAs (Analysis of variance) were used to examine differences. If differences were found Bonferroni post hoc tests were used to allocate where these differences were PASW (version 17) was used for all analysis and alpha level was set a priori at P = 0.05. A non-significant relationship was found between PA and FMS. Significant gender main effects were found with total FMS; with boys mastering manipulative skills more strongly than girls. A Year on Year increase in total FMS was found between Year's 1 and 3 at which point they plateau. These data provide focus for practitioners and scientists to target interventions to increase FMS mastery in primary school children.

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Chapter 1

1.0 Introduction

Declines in physical activity (PA) and increasing obesity levels in children have encouraged increasing interest in understanding children's PA behaviour. Currently in the United Kingdom (UK) an estimated 1 in 3 children in the age range of 4-11 are overweight (NCMP 2010). Existing research in this field have related these statistics with the lack of PA children engage in (Gorely *et al*. 2004; Mackett & Paskins 2008) and the rise in sedentary behaviours such as video gaming or sustained periods of television (Salmon *et al*. 2005).

PA tracking has identified a substantial decrease in PA from childhood to adolescence (Malina *et al*. 1990; Telama *et al*. 1996). This is primarily related to movement skill refinement and the ability to move efficiently and perform these skills competently (Okely, Chey & Booth 2001; Timmons *et al*. 2007). Movement skills track at low-moderate levels during childhood, so greater motor proficiency may be predictive of later PA (Pate *et al*. 2002)

Existing research has focused primarily on older children and adults, therefore research looking at younger children will extend on previous findings (Fisher *et al*. 2005; Wrotniak *et al*. 2006). To study older children may prove too late, given children whom have mastered FMS competencies prior to leaving primary school are more likely to pursue sport and participation in organised/unorganised activities than those whom leave primary school without the ability to perform FMS competently. As a result, these studies could make or break the potential for improved PA in UK children.

The mastery of fundamental movement skills (FMS) is a potential correlate of the involvement of children's PA participation (Welk 1999). These movement skills form the prerequisites for sport competence and other forms of PA (Gallahue & Ozmun 2002; Barnett *et al.* 2009); therefore acquiring these skills during early childhood may increase the likelihood for long term PA. Young children who are equipped with movement skills are more likely to be successful in PA and will be able to seek opportunities to be physically active (Sallis *et al*. 2002; Fisher *et al*. 2005). Children without these skills lack the confidence in their ability, and therefore more likely to drop out of sport and games in the future (Gallahue & Ozmun 2002).

Further opportunities to develop FMS through tailored physical education programs and modified social and physical environments may help address the movement difficulties children experience. Researchers looking at FMS have looked at the relationship between FMS and PA. To date little is known about the correlation between FMS and PA in younger children since the majority of research has focussed on older children and adolescents (McKenzie *et al*. 2002; Wrotniak *et al*. 2006). All the focus on older children and adolescents arguably has little effect in improving PA habits as it may be too late for those children who have not yet already gained prerequisite mastery in the FMS to do so for wider activity benefit. Furthermore, during early childhood the developing neuromuscular systems are at optimal readiness to learn these basic movement skills (Gallahue & Ozmun, 2003; Lubans *et al*., 2010).

Neuromuscular development is forever changing as children mature, such as the development of cognitive, motor, and sensory functions. As children develop gradual shifts occur in their level of functioning in relation to three core classifications of movement skill which include stability, locomotor and object control. Given that the neuromuscular systems are constantly evolving coaching programmes should be stimulated so children can aim to become physically literate (Lubans *et al*. 2010).

Previous research has also relied heavily on using subjective measures and non validated instruments such as self report measures (Fisher *et al*. 2005) to assess PA and its relationship with FMS, therefore further research may benefit from using objective measures of PA (Morgan *et al*. 2008). In regards to this study I will be focussing on using objective measures to assess habitual PA and looking at the relationship between PA and FMS.

This literature review will focus on covering the previous literature on FMS and PA and look at various correlates of the two such as age, gender, weight status.

1.1 Physical Activity and children

Active living and pursuing a lifelong engagement in PA provides many benefits to cardiorespiratory and muscular systems (Anderson & Butcher, 2006; Sallis &Patrick, 1994).

PA is a key component of energy balance and PA is promoted in children and adolescents as lifelong positive health behaviour (Welk *et al*. 1999). Existing research currently shows children are not engaging in enough PA, which is primarily due to an increase in sedentary behaviours such as video gaming or sustained periods in front of the television (Salmon *et al*. 2005; Okely *et al*. 2004). However, more recent findings (Carver *et al*. 2008; Lubans *et al*. 2010) have looked at the environmental influences on PA behaviour and found strong associations with reductions in PA. Carver and colleagues (2008) looked at the environment and PA behaviour and from this it is suggested that reductions in opportunities and reductions in parental support were prime predictors of sedentary behaviour.

Parental support is a big indicator of PA since encouragement and direction from parents influence healthier habits (Gallahue & Ozmun 2002). Pate and colleagues (1997) also agreed with these findings, who stated that children depend on others, such as parents, coaches or teachers for direction and guidance, therefore it could be suggested that a child who absorbs a culture where parents value PA may be more likely to lead an active lifestyle longer term.

PA plays an important role for cognitive, social and physical development and it is well established in the literature that PA helps prevent obesity and other chronic diseases (Weiss &Dziura 2004; Fisher *et al*. 2005; Lubans *et al*. 2010).Statistics in the UK state that only 1 in 3 children are currently meeting the minimum recommended exercise guidelines of 60 minutes of moderate-vigorous physical activity (MVPA) daily (ACSM 1998; Gorely *et al.* 2004). This leaves a major concern for children in the future since it is now recommended by the National Association of Physical Education (NASPE, 2010) that children should be engaging in 120 minutes of exercise daily. It is said that 60 minutes should be organised activity for example PE lessons or sport clubs and the remaining 60 minutes free play for example habitual activity, leisure time.

Organised PA is an important aspect of the curriculum in primary schools, and provides a 'window of opportunity' for children to be physically active (Warburton *et al*. 1996). However, evidence from studies has found that children are not meeting the recommended guidelines of 2 hours quality PE every week (Warburton *et al.* 1996; Fairclough & Stratton 2005). This primarily is due to schools not providing enough high quality PE specialists to carry out these lessons and schools focusing on other lessons such as Numeracy and Literacy, because these skills are considered to be more important (Warburton *et al* 1996).

This is an important concern as mastery of FMS may be maximised in the school setting where PE lessons focusing on development of FMS and all other forms of PA are taught by subject specialists. Primary school settings play an integral part in personal development, health and physical education. The purpose of enforcing FMS proficiency in schools is for the development of children's physical, cognitive and social growth (Payne & Isaacs, 1995).

PA tracking has identified a substantial decrease from childhood to adolescence (Malina *et al*. 1990; Telama *et al*. 1996), which shows that children prior to leaving school have developed more sedentary and less physically active behaviours.

Although the research currently in this area have found declines in PA behaviour amongst childhood, a lot of the research previously has focussed on older children and adolescents, therefore a research priority is to look at working with younger children, so researchers can fully understand the relationship between PA and age and identify some of the determinants for the reported age related decline in PA behaviour (Branta *et al*., 1984; Malina *et al*., 1990; Telama *et al*., 1996).

1.2 Fundamental Movement Skills (FMS)

The mastery of fundamental movement skills (FMS) is widely supported for contributing to children's physical and cognitive development and research widely suggests that these skills form the pre-requisites and foundations for further participation in sport and all other forms of physical activity (Van Beurden *et al*. 2003; Stodden *et al* 2008; Hardy *et al*. 2009; Lubans *et al*. 2010). The development of FMS appears to enhance children's sporting activities and underpin prowess in sport and lifelong PA.

FMS are classified into three major components 1) Locomotor skills, 2) Object control skills, and 3) Stability (Gallahue & Ozmun, 2003; Lubans *et al*. 2010). Locomotor skills refer to movement skills, these skills may include running, jumping, galloping or hopping. Object control skills require the manipulation of an object, skills of this kind would include catching, kicking or throwing a ball. Finally stability refers to body management skills; these may include balancing for example (Haubenstricker & Feldt, 1986). These basic skills are essential for effective participation. For example, a basic overarm throw is essential for sports such as tennis, volley ball and javelin throwing. Without the basic concept of object manipulation, children will not have the ability to progress and potentially lose the opportunities to engage in these activities (Lubans *et al*. 2010).

The acquisition of FMS during early childhood has been identified as an important time to promote physical literacy (LTAD, 2008) and physical fitness.

These skills during this period are critical for children's development, especially while neuromuscular systems are maturing (Gallahue & Ozmun 2002). Furthermore Stodden and colleagues (2008) suggest that the more time spent initially developing these movement skills will increase the likelihood of continued PA behaviour and also improve neuromotor development (Gallahue & Ozmun, 2002). Children without these basic skills are more likely to drop out of exercise and games, due to their incompetence and the loss of confidence in their ability (Gallahue & Ozmun 2002), therefore primary schools which provide a 'window of opportunity' for developing FMS should employ more programs and interventions to develop FMS (McKenzie *et al*., 2002). This could potentially provide the best opportunity for children in developing FMS given that PE is a compulsory part of education. If pupils can be made active as possible and acquire these competencies in structured lessons, along with 'free play' (break times) this may influence the time spent being active as they get older.

Development of FMS during primary school years is particularly important in the provision of structured learning environments (Kirk, 2005), since the contribution of PE specialists in the secondary years of schooling may be too late to impact on the mastery of FMS and movement confidence.

Physical educators or PE specialists provide the catalysts for developing these skills (Seefeldt, 1979) and do more than just provide enjoyable activity for children. The activity children participate in during PE lessons must be made purposeful; therefore PE specialists should look at developing children's mastery and learning developmentally appropriate fitness concepts (Olrich, 2002). If children miss the opportunity to develop FMS, it is likely they will refrain from pursuing PA and enjoying sporting activities (Wrotniak *et al.* 2006) and most likely use withdrawal as a coping strategy. Furthermore, it is suggested that children without these movement competencies are more likely to experience the consequences of ridicule from their peers and feel discouraged from participating in organised activities (Okely & Booth, 2004).

Although FMS plays a fundamental role in schools, these skills not only require reinforcement and good teaching, but also quality assessment. Assessment is important to ensure all children can competently move effectively and perform basic throwing and catching tasks before moving towards more specific sporting activities (Colvin, Markos & Walker, 2000; McKenzie *et al.* 2002), and it is a critical aspect of making sure children continue their personal development and progress. On the other hand, time constraints can be a problem in primary schools; therefore immediate focus could be to employ practical solutions to assessing FMS effectively (Olrich, 2002). This could be achieved through after school classes, planning and making PE lessons more centred on mastering FMS, and setting up community PA in a bid to develop FMS competencies.

FMS assessment is an integral part of measuring one's movement ability and there are a number of ways of assessing these skills. Most methods used to assess FMS are of a qualitative nature where the focus is on technique of the movement (Burton, 1998). Using qualitative assessment provides direct information about movement proficiency whereas quantitative assessment is unable to discern between levels of variability in movement patterns.

In the current study, The Assessment Battery of Movement Skill was chosen. The rationale behind this choice of test was that it formed a high degree of reliability and most of the literature by the widely respected author Okely used this test to assess children's movement skills (Okely et al. 2004; Okely, 2001).

Other possible measures of movement skill include the Test of Gross Motor Development (TGMD-2). The purpose of this standardized test is to measure a range of gross motor abilities that develop early in life. Another form of assessment used to assess motor ability is the Bruiniks-Oseretsky Test of Motor Proficiency (BOTMP). The BOTMP yields a comprehensive index of motor skill proficiency along with separate measures. Although, the test has been applauded for its use in a clinical void and its comprehensive nature; the test did not meet the rationale of the current study. The McCarron Assessment of Neuromuscular Development (MAND), I CAN FMS, and the Cratty-Six-Categories Gross Motor Test are also some of the examples researchers have used to measure movement skill in children and adolescents.

Consistent research has looked at the benefits of FMS and its relationship with PA and evidence has positively associated FMS proficiency with subsequent PA (Lubans *et al*. 2010; Wrotniak *et al*. 2006; Fisher *et al*. 2005). These findings were also reported by Barnett and colleagues (2009) who found FMS proficiency positively associated with sport participation and total MVPA, skill specific and organised activity in children and adolescents. Given their educational and health benefits, FMS is one of the best investments for influencing lifelong PA and for the prevention of obesity by providing children with the perceived physical competence to be physically active (NSW Department of Health, 2003; Konza, Hearne and Okely, 2008).

Although positive associations have been found with FMS and subsequent PA, the associations found were reported been weak to moderate. Additionally, further studies have identified no interaction between FMS and PA (Reed *et al*. 2004; McKenzie *et al*. 2002). To address this matter wider research is required to assess the objective measures of PA and FMS.

A concept consistently brought up in FMS studies is the likelihood of improved self efficacy and perceived competency (Wrotniak et al. 2006; Okely et al. 2004). A child who can confidently manipulate an object is likely to continue in sports such as javelin throwing, softball or basketball. This is because these skills are off a complex nature, and children without movement confidence are far more likely to withdraw from these skills. Furthermore the ability to handle an object competently will more likely give the children the confidence to take up more complex activities where skills such as throwing and catching are important. It could be suggested that FMS are more strongly related to sport participation than PA per say.

FMS competency has been positively linked with increased motivation and self confidence (Sallis 1994; Trost *et al*. 2000). Having the ability to perform movement skills that form the building blocks for further participation in sport and games will increase enjoyment (Okely & Booth, 2001) which is an important factor for children. A lot of children who come out of school with FMS difficulties lack the confidence in their ability in performing those skills, and therefore are less likely to continue in sporting activities (Van Beurden *et al*. 2003; Cairney *et al*. 2005). Children with the inability to perform these skills are also likely to be exposed to ridicule from their peers, which potentially will decrease their confidence further and a child's self perception in their abilities are likely to decrease (Zuvela *et al*. 2010).

Self efficacy remains an important concept in the development of children's movement ability (Gallahue & Ozmun, 2003). The concept behind self-efficacy lies with Albert Bandura's social cognitive theory (Bandura, 1994), which emphasises the role of observational learning, social experience, and reciprocal determinism in the development of personality. One's self-efficacy is underlined as "the belief in one's capabilities to organise and execute the courses of action required to manage prospective situations (Bandura, 2001). Children who don't have the belief in their ability to perform a specific skill or group of skills are considered to have low self efficacy, and therefore are far more likely to withdraw from sport or activities involving these basic skills.

Children who develop a stronger ability to perform FMS will likely develop self confidence in their abilities and stronger self efficacy through their mastered experiences (mastery of FMS). Performing a task successfully increases self confidence, elevates positive thoughts and beliefs in their performance (Bandura, 2001; Bandura, 1977). On the other hand, children who don't master FMS are more likely to experience low self efficacy in these movement skills because they have not acquired the basics, therefore will quickly lose confidence and believe that difficult tasks involving these movement skills are beyond their capabilities. Providing children with the necessary skills to be active and perform more difficult tasks will help improve one's self efficacy which will show in their performances (Robinson *et al*. 2011).

1.3 PA and FMS

Researchers often suggest that refining FMS prior to leaving primary school is necessary for children and adolescents to enjoy recreational activities (Gallahue & Ozmun 2003; Van Beurden *et al*. 2003; Barnett *et al*. 2009).These research studies have focussed on the hypothesis that children with poorer movement skills will withdraw from PA compared with those who have a better understanding and ability of FMS (Graf *et al*. 2004; Fisher *et al*. 2005; Wrotniak *et al*. 2006). To date there have been few findings looking at FMS and younger children (Early Years/Key Stage 1) and whether habitual PA is associated with FMS (Hands 2007; Tudor *et al*. 2004). The research currently has found positive associations with FMS and PA; however, very few results have concluded the relationship (Van Beurden *et al*. 2003; Okely *et al*. 2004; Wrotniak *et al*. 2006; Lubans *et al*. 2010). Differences in research design, measures of movement skill and the methods of PA assessment have contributed to the inconclusive nature of these findings.

The association between FMS and PA to date is particularly weak (Okely *et al*. 2004; Fisher *et al*. 2005) with other research studies (McKenzie et al. 2002; Reed, 2004) finding no association with FMS and PA. Although research has yet to consider that FMS proficiency is positively related to habitual PA, it is likely that FMS are more strongly related to sport participation rather than PA. Other factors such as family and community values, expectation and support, self motivation, and interest could all play a considerable part to the relationship between PA and FMS.

One of the factors that may account for the weak findings is the accuracy of assessment used to assess PA in children (Morgan *et al*. 2008; Duncan *et al*. 2007; Tudor *et al*, 2004). There is no consensus in the literature on the methods that should be used when assessing PA. However, self report measures such as CSAPPA and the self recall questionnaire have been criticised for the instruments weak validity and reliability (Guimaraes Vale *et al*. 2010; Morgan *et al.* 2008; Duncan *et al*. 2007). This is because self report measures are based on opinion and how children perceive their ability, and therefore limits the direct measurement or observation of behaviour and energy expenditure. Using an objective measurement of PA may facilitate the findings between PA and FMS given these devices measure the type, time, and intensity of movement. Examples of objective instruments include pedometers (Yamax Digiwalker 2000), heart rate monitors, and activgraphs (MTI 7164, CSA 7164) which have been extensively validated for the assessment of PA (Fisher et al. 2005; Janz et al. 1995)

Valid assessment of PA is important to researchers and practitioners interested in surveillance, screening, evaluation and intervention. Objective measures such as accelerometers, Global positioning systems (GPS), and pedometers have been highly accredited for their accuracy and validity (Cox *et al*. 2006), and their capability of accurately documenting the degree, nature and pattern of activity. These devices are a practical, cost effective and provide a positive way of determining activity patterns. Given their objectivity these devices should be a primary consideration when choosing an instrument to assess PA.

One of the most accurate and most validated measures of assessing children's PA is the accelerometer (Bassett, 2000; Janz et al. 1995). Accelerometers have been extensively validated for their accuracy and direct observation of movement. One of the most validated accelerometers to date is the MTI 7164 model, which has been considered a feasible method for assessing PA. Although accelerometers provide the best method to assess PA, these can be expensive, especially with a larger group sample. Another validated measure of assessing PA is pedometers. These small devices detect movement and are a widely used instrument to assess PA (Sirard & Pate, 2001). To date the most reliable and accurate pedometer is the Yamax Digiwalker (SW-200) and a number of validation studies (Kilanowski *et al*. 1999; Sirard & Pate, 2001; Schneider *et al.* 2004) have supported this device for their precision and direct assessment of movement. Although pedometers are a feasible way to assess PA in children, there are potential limitations, for example risk of equipment failure, risk of loss and tampering and its inability to provide information on the intensity or the temporal location of PA (Sirard *et al.* 2001; Pate *et al.* 2002). The use of pedometers can also result in the case of participants modifying their behaviour due to the constant reminder that their PA is being assessed (Crouter *et al.* 2003; Ridgers *et al.* 2006). Nonetheless, pedometers are the likely choice of measurement to assess PA (Crouter *et al*. 2003) and given the bulk of human activity is 'ambulatory' pedometers although questionable, are a reasonable choice of instrument.

Studies to date using objective measures have tended to focus on older children and adolescents (Fisher *et al*. 2005; Wrotniak *et al*. 2006), for that reason assessing PA in younger children is priority. If FMS proficiency is a determinant of PA in children, then strategies that increase FMS in early childhood may be of importance for helping promote PA and improve health in children (Graf *et al*. 2004; Wrotniak *et al*. 2006).

Consistent research (Barnett *et al*., 2009; Lubans *et al*., 2010) has looked at FMS as a predictor of adolescent PA and from this research is it clear to say that object control proficient children are more likely to be active adolescents. The assumption that object control skills (catching, throwing) predict subsequent PA is due to the results found by Barnett and colleagues (2009) who suggest these type of skills are associated with PA experiences of a MVPA intensity (Raudsepp *et al*., 2006). Okely and colleagues (2001) also investigated whether FMS predicted PA and it was concluded from the study that those whom were most physically active, were those who achieved near mastery/mastery in FMS. Although these skills have been linked with long term PA, having greater FMS ability in all movement skills (locomotor skills, manipulative skills, body management skills) result in greater self confidence and enjoyment, therefore implementing a curriculum where FMS are the focus for all children would provide potential benefits for longer term PA.

1.4 Gender and FMS

Numerous studies (Sallis *et al*. 1999; Okely *et al*. 2001; Van Beurden *et al*. 2002; Fisher *et al*. 2005) have explored the differences between gender and FMS ability. It is well documented currently from these studies that males have a higher mastery of object control skills, and females to be more proficient at skills involving body management (balance) and movement skills (locomotor).

The research currently geared towards gender and FMS have linked these findings with more environmental reasons, such as parental expectations, motivation and family or community values (Sallis 1999; Trost *et al*. 2000). On the other hand biological factors have been considered a potential factor for gender and FMS. One of the most consistent factors that researchers pick up on is the possibility of brain organisation between sexes (Kimura, 1996; Thomas & French, 1985). It is evident that males, on average, perform better than females in certain spatial tasks (throwing, kicking a ball, and catching). Primarily this is due to hormonal differences between sexes, which have been proven to affect cognitive patterns. Males have a greater level of testosterone and androgen levels, which has been scientifically proven to influence spatial performance (Kimura, 1996). Furthermore, higher testosterone levels elicit greater strength and muscular gains, which therefore will influence how far they would be able to manipulate an object. However, since boys and girls are very similar physically prior to puberty (Hardy *et al*. 2009) this may not be the case with the younger children. Genetic differences may also be a factor contributing to good spatial ability; someone whose parents were competent with visuo-spatial ability is likely to directly inherit these skills (Casey, 1996).

Although there are possible sex differences in brain organisation and genetics, studies have associated the difference with socialization factors (Barnett *et al*. 2009), which are influenced by family values, peers, and teachers. There have been suggestions that males have a greater opportunity to practice these skills in comparison to females. Most of this is due to family expectation, for example fathers expect their sons to be involved in sport and tend push them to be involved in sports such as football, rugby, and basketball where manipulation of an object is important. Previously it was discussed that object control skills predict future PA, from this it could be suggested that boys are more likely to be physically active adults compared to girls (Barnett *et al.* 2009). Moreover, in the literature it has been discussed that reinforcement children receive may also be a contributing factor. Future recommendations could be to reinforce more community sport where both boys and girls have equal opportunities, and involving parents may also improve the effectiveness of FMS for both sexes (Thomas, 2000; Thomas & French, 1985).

Previous findings and assumptions have found that girls tend to be involved in activities such as dance or gymnastics (Okely 2001; Hardy *et al*. 2009) which refine skills such as fine gross movement and postural control such as balancing (McKenzie 1999; Okely & Booth, 2004). From this, it could be suggested that girls should perform overall better in skills such as balancing, locomotor skills compared to boys.

Although these factors may reflect the findings with gender differences and FMS, it is apparent that boys are more physically active than girls (Hume *et al*. 2008; Lubans *et al*. 2010). A number of studies support this and also commented that boys are more active than girls from preschool age through to adolescence (Baranowski *et al*. 1993; Finn *et al.* 2002; Jackson *et al*. 2003; Kelly *et al*. 2006). A more recent study by Hume and colleagues (2008) concluded from that particular study that girls were less active than boys and that boys had greater mastery/near mastery than girls did in the battery of movement skills. This leaves concern of potential risk for inactive lifestyles when compared to boys (Finn *et al*. 2002) and could suggest that boys are more competent in performing FMS, since they engage in sport and games more often than girls giving them more time to refine skills like catching and running (Fisher *et al*. 2005; Hardy *et al*. 2009).

Although there have been studies that have identified gender differences between skills, more research is a priority for us to find where these differences lie. A question that is yet to be answered is are boys more competent at FMS due to physical reasons (biological factors) or is it due to the quality and quantity of exercise boys engage in compared to females? From these findings it could provide the data needed to push for structured opportunities for girls targeting object control skills, also providing gender separated games may help develop both girls and boys in each of the movement skills.

1.5 Weight Status and FMS

Weight status and FMS ability is an area well documented, and currently research has looked at the relationship between obese/non obese children and FMS proficiency (Okely *et al*. 2004; Trost *et al*. 2005; Wrotniak *et al*. 2006). Current findings from these studies associate an inverse relationship between obesity and FMS proficiency.

Body mass index (BMI) is a widely used instrument to assess weight status in children and adolescents (Dietz & Bellizzi, 1999) and International definitions are available to allow of classification of BMI in children as 'normal weight' , 'overweight' and 'obese' (Cole *et al*. 2000). Previous Studies have found that children with higher BMI perform locomotor skills such as running and hopping less competently than children with a less BMI. Deforche and Colleagues (2008) performed a study looking at FMS and the differences in a sample of obese and healthy weight children.

From this study the findings demonstrated that children with higher mass perform locomotor and postural skills, such as balancing poorer than children with a lower mass. These differences have been linked to geometric changes, which larger children tend to have, as result causing postural constraints and impaired FMS performance (Deforche *et al*. 2009). Okely, Booth and Chey (2004) also found differences between weight status and FMS performance outlining that children with a heavier distributed mass find it more difficult with coordination and moving their limbs effectively. Although, results have found associations between weight status and movement skill, the findings have only reported weak-moderate associations. It is important that more research in this area is commended to extend on previous findings.

Although BMI is a widely assessed instrument for measuring obesity and weight status in children and adolescents, there are limitations with this instrument. Firstly, BMI is a simplistic method and is determined by height and weight (kg/m_2). Secondly, and most importantly the method does not determine the difference between fat mass and lean body tissue. Therefore, the accuracy of this instrument can be questioned (Dietz & Bellizzi, 1999; Cole *et al*., 2000). Consequently, future research would benefit from using more accurate techniques such as skinfold measurement, air displacement plethysmography or hydrostatic weighing to more accurately determine weight status in children and adolescents. Despite the controversy regarding body composition methods, for the current study BMI was the most suitable at the time, given the large number of children taking part and the finances available to carry out the study.

A study by Hume and colleagues (2008) looked at the influence of weight status between children's FMS and PA and it was evident that the obese group in both boys and girls were potentially less competent and less active. Future research using a wider selection of FMS and types of activity to better understand this relationship may provide better results (Hume *et al.* 2008). Other studies (Davies *et al*., 1995; Sallis *et al*., 2000) also supported these findings, concluding that more research looking at FMS, PA and Weight status in a wider of sample of movement skills would close the gap so more effective programs and interventions are in place to improve PA.

1.6 Age and FMS

The brain plays an integral part to the development of FMS throughout childhood and maturation. As we grow with age the organisation of the brain changes with myelination which refers to the way we transmit impulses from the brain to the central nervous system

(CNS) through to the muscles. Prior to puberty, brain organisation is immature and cannot function well, however after myelination brain organisation starts to mature and motor neurones mature fulfilling their designated functions more efficiently (Bellis, 2001).

The CNS consists of the brain and both the sensory and motor nerves. The sensory nerves are responsible for the relay of sensory information to the brain, whereas the motor nerves are responsible for carrying information to the skeletal muscles, stimulating them to contract and perform work. The structural maturation of individual brain regions and their connecting pathways is required for successful development of cognitive, motor and sensory functions (Bellis, 2001). This maturation eventually provides for a smooth flow of neural impulses throughout the brain and the CNS. When children start to mature brain organisation begins to develop and gradual shifts occur in their level of functioning of the three core classifications of movement skill; these include locomotor, object manipulation and stability. Generally, larger muscle groups develop before smaller muscle groups and in children, where the neural pathways to the muscles are constantly evolving. Therefore providing structural coaching programmes to program this information and stimulate these three types of movement skill will facilitate the development of movement skill and improving brain organisation (Bellis, 2001).

Physical literacy is a term used to describe one’s ability to stimulate a number of muscle fibres collectively and coherently to produce skilled movements. With this in mind, it could be suggested that focussing on developing FMS during early childhood may prove beneficial for lifelong participation in PA and sport which rely heavily upon locomotor skills, object manipulation and stability.

The tracking of PA (Malina, 1996) has clearly shown a decline in the quality and volume of PA during childhood and adolescence. This potentially leaves concern, given the importance of introducing positive behaviours towards exercise and the enjoyment of being active (Lubans *et al*. 2010).

During early childhood the fundamental motor phase (Gallahue & Ozmun, 2003) reflects the phase which young children should competently be able to move effectively and demonstrate competency in FMS, such as running, hopping and jumping. It is an important time for children to develop these competencies, during the fundamental motor phase, so these skills can be applied to practice in further activities when children mature (Gallahue & Ozmun, 2001).

Through Primary school Years these movement skills should be able to develop and consistently improve as children's bodies mature and grow (Okely &Booth, 2004). However studies (Okely & Booth, 2004; Branta *et al*. 1996) have shown there is a negative association with age and FMS, showing very little development and even declines in performance in each of the movement skills. The study by Okely and Booth (2004) focussed on Years 1-4 (6-9 Years) and found that FMS did not change as such as children matured. There was a slight change in skill differences by a maximum of 35% for each of the skills, however the prevalence of FMS mastery is low and shows need for improvement. From this, it could be suggested that primary schools, which provide the opportunity for children to develop their FMS should employ more programs and supply more time with focussing on developing these movement skills before playing more sport specific games/activities. Furthermore, it was identified from this study that object control skills, particularly the throw was mastered more slowly than the locomotor skills (running, jumping) through Years 1 and 4 (Okely & Booth, 2004), suggesting that programs should maybe emphasise object skill mastery into these programs, given that object control proficiency has previously been found to predict long term PA in children and adolescents (Van Beurden *et al*. 2009).

1.7 Aims and Objectives

The primary aim of this study is to assess the relationship between FMS and 'Habitual' PA over six Year groups in a West Midlands local Primary School.

Secondly, while examining the two the study will focus on various correlates such as age, gender and weight status.

Both 'Mastery' of the FMS (subjective) and performance of the FMS (objective) will be examined to look at the association between the two.

1.8 Hypotheses

From the reviewed body of literature of FMS and PA in children the following experimental hypotheses will be examined in this study:

1) There will be a relationship between FMS and PA between gender groups.

2) There will be significant improvement from Years 1 to Year 6.

3) Normal weight children to have higher FMS 'mastery' than those who are overweight or obese.

4) There will be FMS differences between gender groups.

The null hypotheses for this study will be the opposite to those of the experimental hypotheses provided.

Chapter 2

2.0 Methods

2.1 Study Design

This study employed a cross sectional design to investigate the relationship between FMS and PA. The variables investigated in the study were FMS Mastery, Habitual PA (step count), Gender, Age and Weight Status.

2.2 Participants

Full approval from the ethics committee at Coventry University was given prior to the study. A total of 264 children (n=126 boys, n=138 girls), mean age of 8.8 ± 1.6 Years from a local Primary School in Coventry agreed to take part. Children were from school years 1-6 (ages 6-11) and where from Caucasian (81.4%), Afro-Caribbean (1.5%) and South Asian (17.1%) ethnic backgrounds.

Inclusion and exclusion eligibility was given prior to the study and informed consent was obtained from the parent/guardian of the child. Child ascent was also provided to confirm their interest in the study. Only children who were healthy and free of diagnosed physical impairments or illness were to take part. All children taking part were advised to wear correct PE uniform when taking part in the series of physical tests. Full risk assessment from the researchers and approval from the committee at Coventry University was carried out.

2.3 Anthropometric Measures

Body height and mass were determined to the nearest cm and 0.1kg respectively using a Seca stadiometer and electric weighing scales (Seca Instruments Ltd, Germany). From this body mass index (BMI, kg/m^2) was determined. This measurement is a widely used technique to assess weight status in children and adolescents (Must *et al*., 1991; Cole *et al*. 1999; Dietz *et al*. 2001).

Despite its limitations, BMI was the most suitable technique for the current study. Furthermore, the study was funded by the Coventry City Council and the chosen method by the council was BMI, therefore the researcher was in no position to adopt a different approach to the assessment of weight status for the study.

The weight status of each child was classified according to International Obesity Task Force (IOTF) criteria (Cole *et al*., 2000). Using the IOTF criteria, each child were coded as ‘normal weight’ or ‘overweight/obese.’ This criterion has widely become an assessable and reliable method to determine direct trends in childhood obesity, which has been based on the widely accepted International cut off points for adults (Malina *et al*. 1997; Troiano *et al*. 1998; Cole *et al*. 2000).

2.4 Data Collection

Data collection took place during the months of January and June, 2011. Children, whose parents returned informed consent and child ascent, were included in the study. Children were all supplied with a pedometer and instructions were all given prior to the children taking the pedometer home.

Each child had the opportunity to test the pedometer during their PE lesson to get used to wearing and understanding how the pedometer works.

Children were instructed to wear the pedometer for a period of four days, consisting of both week day and weekend days (Thursday, Friday, Saturday, Sunday) and return the pedometer the next school day (Monday) to the classroom teacher ready for the researcher to collect. Given that the bulk of all human activity is ambulatory the researcher chose to use pedometers as the direct measurement to determine habitual PA of each child. These devices are currently the most reliable and valid measurement tool for ambulatory activity and children (Tudor-Locke *et al*. 2004; Duncan *et al* 2007).

The FMS and anthropometric data (BMI) were completed during Physical Education Time, with each session lasting 60-90 minutes respectively.

2.4.1 Habitual PA Monitoring

A Yamax Digi-Walker SW-200 pedometer (Japan, Tokyo) was used to estimate daily step count. To date, this is recognised as the most reliable and most accurate pedometer and a number of validation studies (Kilanowski *et al*., 1999; Sirard & Pate, 2001; Schneider *et al.,* 2004) have supported this precise direct measurement device.

2.4.1.1 Procedures

Children were each provided with a Yamax Digi-Walker and all were given detailed instructions on how and when to wear the pedometer. A letter was sent out to parents also providing detailed instructions. Step counts were consecutively measured over 4 days, which consisted of 2 weekdays (Thursday, Friday) and weekend days (Saturday, Sunday), meeting the recommendations of 4 days of measurement (Duncan *et al.* 2007; Trost *et al*, 2000) for the assessment of habitual physical activity. Parents/Guardians were instructed to encourage their child to wear the pedometer throughout the day, from waking up in the morning until bedtime, and remove when exposed in water or sleeping. Instructions were also given for positioning of the pedometer (positioned on the belt or waistband above the thigh), and to encourage their child not to tamper with device, to prevent error with the steps accumulated.

Parents maintained a record of the number of steps taken, and were encouraged to write down the type of activity taken and the duration played for (see appendix 2). Each day the pedometer was reset every morning by parents before it was attached to the child’s waistline. Parents recorded the time and reason if the pedometer had been removed during the day.

Previous studies (Kusta, 2001; Desa, 2001; Spilner& Robertson, 2000) have investigated the recommended cut points for steps/per day. It is clear that children should be accumulating 10,000 steps each day for both boys and girls. However, more recently studies by Duncan (2007), Tudor-Locke and colleagues (2004) have recommended girls to be performing 12,000 steps/per day and boys 15, 000.

In the current study, there were a number of data points missing from the collected pedometer step counts. Primarily, this was due to the number of children whose parents would not consent their child to taking part in this particular part of the study. Secondly a significant reduction in the number of subjects was caused by the low compliance of children and parents with the pedometer use and recording of data.

2.4.2 FMS Procedures

A battery of physical tests were carried out and consisted of three types of skill; 1) Locomotor, 2) Object-Manipulation and 3) Body Management skills. These three types of skills were tested to allow the researcher to find out the children's ability to perform fundamental skills, which form pre-requisites for further participation in sporting activity (Okely, Booth and Chey, 2004;Gallahue & Ozmun, 2002). A total of seven tests were assessed: sprint, side-gallop, hop, jump, throw, catch and balance. These tests were used for this study, given their high profile from previous FMS studies (Barnett *et al.* 2009, 2008; Junaid *et al.* 2006; Okely *et al*. 2001 Raudsepp and Paasuke, 1995).

Standardized test procedures were followed and arrangements were made to accommodate the test in a safe environment and to minimise administration time and distractions. Full risk assessments were taken prior to testing to establish a safe location for performing the tests.

Testing was completed as part of the children's physical education lessons, to minimise distractions with other lessons the children had during the day. Four examiners were involved in the test administration in each of the testing sessions. Two stations were set up such that one tester and one videographer (Sony, HDV 1080i camcorder) were at each station, all locomotor, body management and object manipulation skills were completed simultaneously.

For each session, children were provided with a sticky label with a number written on. Children were encouraged to keep their label and keep in register order, so when the researcher comes to analyse the recorded skills it would be easier to determine who was performing that specific skill. Prior to testing the researcher and PE specialist carried out a thorough warm up using dynamic movement drills and games to help minimise injury and maximise their performance (Fairclough & Stratton, 2005).

Testers provided a verbal description and an accurate demonstration of each skill. The testers read directions to the children as stated in the script provided (NSW, 2000) and followed up by performing the skills emphasising the criteria to be assessed. The criteria used in this study was in accordance to the Move It, Groove It resource (NSW, 2000), which has been widely disseminated to help enhance FMS development in children (Hardy *et al*. 2010;Stodden *et al.* 2008; Okely *et al*. 2004 Van Beurden *2003*; Van Beurden *et al.* 2002). Children were allowed questions after the demonstration, and if necessary, the testers provided one additional demonstration.

Feedback was kept minimal and was only in the form of ‘run fast’ or ‘jump high.’ If the child did not complete the skill to their best effort the child was asked to repeat the trial again with increasing speed or force. This occurred approximately 20% of the time during the sprint tests, given children were consistently jogging rather than sprinting as fast as they could.

For the sprint, side-gallop and hop a 10m track was marked up using a tape measure. The floor was marked up with masking tape to facilitate consistency of equipment set up during subsequent test days, and help speed up the testing. Each child was allowed three attempts for each of the skills and was encouraged to complete the test as best they could. The countermovement jump was performed using a Globus jump mat (Globus, Coventry, UK). All children were to focus on their technique and jump as high as they could over three trials.

For the object manipulation skills, a softball was used over the three trials. The throw was performed using a marked target on the wall with a distance of 5m. Children were asked to throw using an over arm action as close to the target as possible, focussing on their technique and the cues provided during the demonstration. Likewise, a distance of 5m was used for the catch and testers/PE specialists were to throw the ball using an underarm action (maximum of 2m high). Children were encouraged to catch the ball as best they could, focussing on cues provided (NSW, 2000). For the balance tests, both subjective and objective measurements were taken. This way the researcher could look at the relationship between the technique and performance.

To assess balance subjectively children were asked to balance for 20 seconds using their dominant leg over three trials. To assess balance objectively, the MFT S3 check balance board test was used (MFT S3-Check, Germany). The MFT S3-Check is a highly valid measurement to assess an individual's ability to balance. Numerous Validation studies have approved the test's reliability and validity to objectively assess one's ability to balance (Mildner *et al*. 2010; Rascher *et al*. 2008).

The concept behind the test is to measure the movements of the platform, which calculates the sensory motor index based on the number and magnitude of movements made (Rascher *et al*. 2008). Each Child had one attempt to balance as best they could on the platform for 20 seconds. Children were encouraged not to use the handles and to focus on a target the researcher used to help the children concentrate and focus on the task. Each movement skill had a set of technical components, which represented mature patterns of the FMS. These components were presented as performance criteria and varied from 5 to 6 among skills. Each FMS was subsequently analysed using video analysis.

To determine all FMS results were consistent and reliable, inter-rater reliability was used. This is a recognised process in research, given researchers have been known to be notorious for their inconsistency. Firstly all video clips were analysed and then verified by the researcher. Two internal examiners from the University were then selected and each was given a selection of movement skills to observe and provide a rating of which they felt was appropriate from the video clips provided. Once each examiner calculated their mastery scores these results where then exchanged between them and verified for a final rating.

The videos of each skill was slowed down and carefully analysed using Quintic Software (Quintic, Coventry, UK) to allow the researcher to accurately assess each of the criteria set for all the skills. Using the performance criteria (NSW, 2000) the performance of each child was numbered for 'mastery' of each of the skills (See Appendix B). For those who ticked all the boxes was classified as 'mastery' and for those who missed certain criteria were classified as 'near mastery' depending on the number of criteria reached. The following calculation was used to assess mastery of each of the movement skills; components achieved /total number of components x 100. This was used subsequently for each of the movement skills respectively.

2.4.2.1 Objective measures

To accurately assess the battery of FMS tests and for concurrent validity amongst the skills, objective measures of FMS were assessed. For the sprint SMARTSPEED light gates (SMARTSPEED, Coventry, UK) were used to assess sprint time.

The countermovement jump was performed using a Globus jump mat (Coventry, UK) and balance was measured using the MFT S3-check balance board test (MFT S3, Germany). Pearson moment correlations indicated a significant relationship between subjective and objective measures of FMS. If children scored highly on FMS mastery they also scored highly on an objective measure of the same type of skill performed. In the present study, both sprint (r = 1, p = .014) and jump (r = 1, p = .000) had significant relationships.

2.5 Data Analysis

Pearson's product moment correlations were computed to examine relationships between FMS, PA and weight. All data was undertaken using SPSS version 17.0. Means and standard deviations were calculated for all normally distributed variables.

A series of 2 (gender) by 6 (Year group) by 2 (gender) ANOVAs employing backwards elimination to achieve a parsimonious solution were used to assess any differences for each of FMS. Bonferonni post hoc tests were used to indicate where these differences lay. Bonferonni post hoc samples were chosen, as this method is considered the most conservative and is the most commonly used post hoc test by practitioners and scientists (McKenzie *et al.* 1998; Provost *et al.* 2007). A P value of 0.05 was set a priori to establish statistical significance.

Recognizing that FMS and PA data was positively skewed and not satisfactorily normally distributed, a log transformation was used to overcome skewness and non-normality. Both FMS and PA data was subjected to non parametric methods to confirm the log transformed ANOVA results. Partial eta^2 was used as a measure of effect size. This was used to give an indication of the effect of one variable on another rather than the P value which just indicates if they're significantly different.

Chapter 3

3.0 Results

Correlations

There was no significant relationship between FMS and BMI (all *p*= >0.05). Significant relationships were identified between side gallop (*r* = -.125, p = .042), hop (*r* = -.59, *p* = .007), throw (*r* = -.125, *p* = .042), balance (*r* = .146, p = .018) and BMI. In all cases higher BMI was associated with poorer FMS mastery. The remaining FMS; sprint, jump, catch were not statistically significant (all *p*>0.05). No significant relationships were found between any component of FMS and PA (all *p*= >0.05). The Pearson Moment Correlations for FMS, BMI and PA are presented in Table 3.0.

Table 3.0. Pearson Moment Correlations for FMS, BMI and PA. Data expressed as r value and p values

FMS	*BMI*	*PA*
Sprint	*r = -.049*	*r = .058*
Side-Gallop	*r = -.125* *****	*r = -.005*
Hop	*r = -.059* *****	*r = .089*
Jump	*r = .060*	*r = -.099*
Throw	*r = -.125* *****	*r = .046*
Catch	*r = .046*	*r = -.065*

Balance	*r = .146* *****	*r = -.145*

*represents statistical significance (*p = <0.05*)

Descriptive Statistics

Results presented in Table 3.1a illustrate each FMS across all Year groups 1-6. Data is expressed as Means ± Standard deviations for all Years. Throughout each Year group it is evident that the majority of FMS progressively increase from Years 1-3, and begin to plateau between Years 3-6. Clearer results are presented in Figure 3.0.

Table 3.1a. The Percentage mastery for each FMS for Years 1-6. Data expressed as Means ± Standard Deviations.

	FMS						
Year Group	Sprint	Side-gallop	Hop	Jump	Throw	Catch	Balance
1	87.7 ± 12.2	*81.1 ± 18.2*	75.8 ± 14.3	*66.7 ± 18.4*	*74.6 ± 17*	*69.3 ± 21.7*	*55.8 ± 21.7*
2	*80.6 ± 12.9*	*75.3 ± 13.6*	*70.3 ± 12.1*	*78.2 ± 9.6*	*66.2 ± 15.2*	*68.1± 18.4*	*66.1 ± 12.5*
3	*80 ± 17.9*	*89 ± 13.5*	*78.4 ± 14.3*	*80.3 ± 17.6*	*82 ± 12.4*	*83 ± 14.3*	*79.4 ± 20.7*
4	*83 ± 11.7*	*87 ± 18.5*	*73 ± 16.7*	*84 ± 9.9*	*77.2 ± 12.8*	*81.1 ± 14.4*	*75 ± 15.3*
5	*75.7 ± 16.7*	*82.3 ± 17.8*	*76.8 ± 13*	*85.1 ± 15*	*81.3 ± 15*	*81.3 ± 16.7*	*80.7 ± 16.9*
6	*88.9 ± 10.1*	*89.4 ± 14.2*	*78.8 ± 13.2*	*87.1 ± 12.9*	*87.1 ± 12.9*	*86.4 ± 18.2*	*78 ± 13.7*

Results presented in Table 3.2 illustrate FMS mastery across gender groups. For each FMS, percentage mastery is expressed as Means ± Standard Deviations for both boys and girls. FMS mastery for both genders was relatively balanced, however significant main effects were found amongst some of the skills (refer to Figure 3.1a, b).

Table3.1b Log transformed mean values and the 95% confidence intervals for each FMS for Years 1-6.

Year	Log Sprint	95% intervals	Log Side-gallop	95% intervals	Log Hop	95% intervals	Log Jump	95% intervals	Log Throw	95% intervals	Log Catch	95% intervals	Log Balance	95% intervals
1	4.437	4.332 -4.541	4.311	4.195 -4.427	4.236	4.133 -4.339	4.142	4.041 -4.242	4.213	4.092 -4.334	4.123	3.993 -4.253	3.968	3.826 -4.111
2	4.349	4.270 -4.427	4.245	4.158 -4.331	4.176	4.099 -4.253	4.336	4.260 -4.411	4.114	4.042 -4.205	4.150	4.053 -4.248	4.163	4.057 -4.270
3	4.335	4.269 - 4.400	4.428	4.355 - 4.500	4.298	4.233 -4.362	4.344	4.281 -4.408	4.365	4.289 -4.442	4.395	4.313 -4.477	4.297	4.208 -4.386
4	4.384	4.319 - 4.449	4.385	4.313 -4.458	4.208	4.144 -4.273	4.411	4.348 -4.473	4.294	4.218 -4.369	4.342	4.260 -4.423	4.295	4.206 -4.384
5	4.279	4.216 -4.341	4.337	4.268 -4.406	4.289	4.228 -4.351	4.411	4.352 -4.471	4.366	4.294 -4.438	4.373	4.295 -4.450	4.340	4.255 -4.425
6	4.459	4.392 - 4.526	4.429	4.354-4.36504	4.297	4.231 -4.363	4.439	4.375 -4.504	4.202	4.123 -4.280	4.397	4.313 -4.480	4.336	4.245 -4.428

Table 3.2. Mean ± S.D of FMS across gender groups

Gender	Sprint	Side-Gallop	Hop	Jump	Throw	Catch	Balance
Boys	*83.6 ± 14.3*	*84.5 ± 17.2*	76.7 ± 13.6	*81.3 ± 16.3*	*77.9 ± 15.6*	*83.7 ± 16.3*	*70.2 ± 17.8*
Girls	*80.5 ± 15.2*	*85 ± 16.1*	*75 ± 14.9*	*82.7 ± 13.3*	*75.6 ± 16.3*	*82.7 ± 13.3*	*79.4 ± 17.1*

Results presented in Table 3.3 show the Means ± Standard Deviations for FMS mastery across each weight status group. The majority of the FMS were equally mastered throughout both groups, however, significant main effects were identified (refer to Figure 3.2).

Table 3.3. Mean ± S.D of FMS across weight status groups

Weight Status	Sprint	Side-Gallop	Hop	Jump	Throw	Catch	Balance
Normal Weight	*82.5 ± 14.7*	*85.8 ±15.8*	*76.9 ±13.8*	*81.9 ±14.2*	*77.4 ±15.2*	*80.2±18.6*	*74.4±17.9*
Overweight/ Obesity	*80.1±15*	81.2±19	*7 2 ±15.3*	*82.8 ± 16.7*	*78.5 ±14.5*	*78.5 ± 14.5*	*77.3 ± 18.4*

Results presented in Figure 3.0 Show the Mean ± S.D for each FMS across school Year (1-6). Significant school Year main effects were evident for side-gallop ($F_{5,\ 258}$, 3.481, p = .005, Partial eta^2 = 0.89), jump ($F_{5,\ 258}$, 6.98, p = .000, Partial eta^2 = .121), throw ($F_{5,\ 258}$, 6.513, p = .000, Partial eta^2 = .121), balance ($F_{5,\ 258}$, 6.48, p = .000, Partial eta^2 = .109) and hop ($F_{5,\ 258}$, 2.26,p = .049, Partial eta^2 = .050). Bonferroni post hoc tests indicated that in all the FMS, mastery significantly increased from school Years 1 to 3 at which point it plateaued from Year 3 to 6.

Significant main effects were also evident for sprint ($F_{5,\ 258}$, 4.661, p = .000, Partial eta² = 0.83). Bonferroni post hoc tests indicated year one to have significantly greater mastery than Year 5 ($F_{5,\ 258}$, 5.523, p = .025) and Year six significantly greater mastery than both Year 3 and 5 ($F_{5,\ 258}$, 5.523, p = .001).

Results presented in Figure 3.1 illustrate the Mean ± S.D for each FMS for both boys and girls. ANOVAs indicated significant gender main effects for balance ($F_{5,\ 262}$, 8.530, p = .004, Partial eta² = .032), and catch ($F_{1,\ 262}$, 13.677, p = .000, Partial eta² = 0.53) with girls having greater mastery of balance, but poorer catching mastery than boys. Mastery for the remaining skills (sprint, side-gallop, hop, jump and throw) was relatively similar across gender groups.

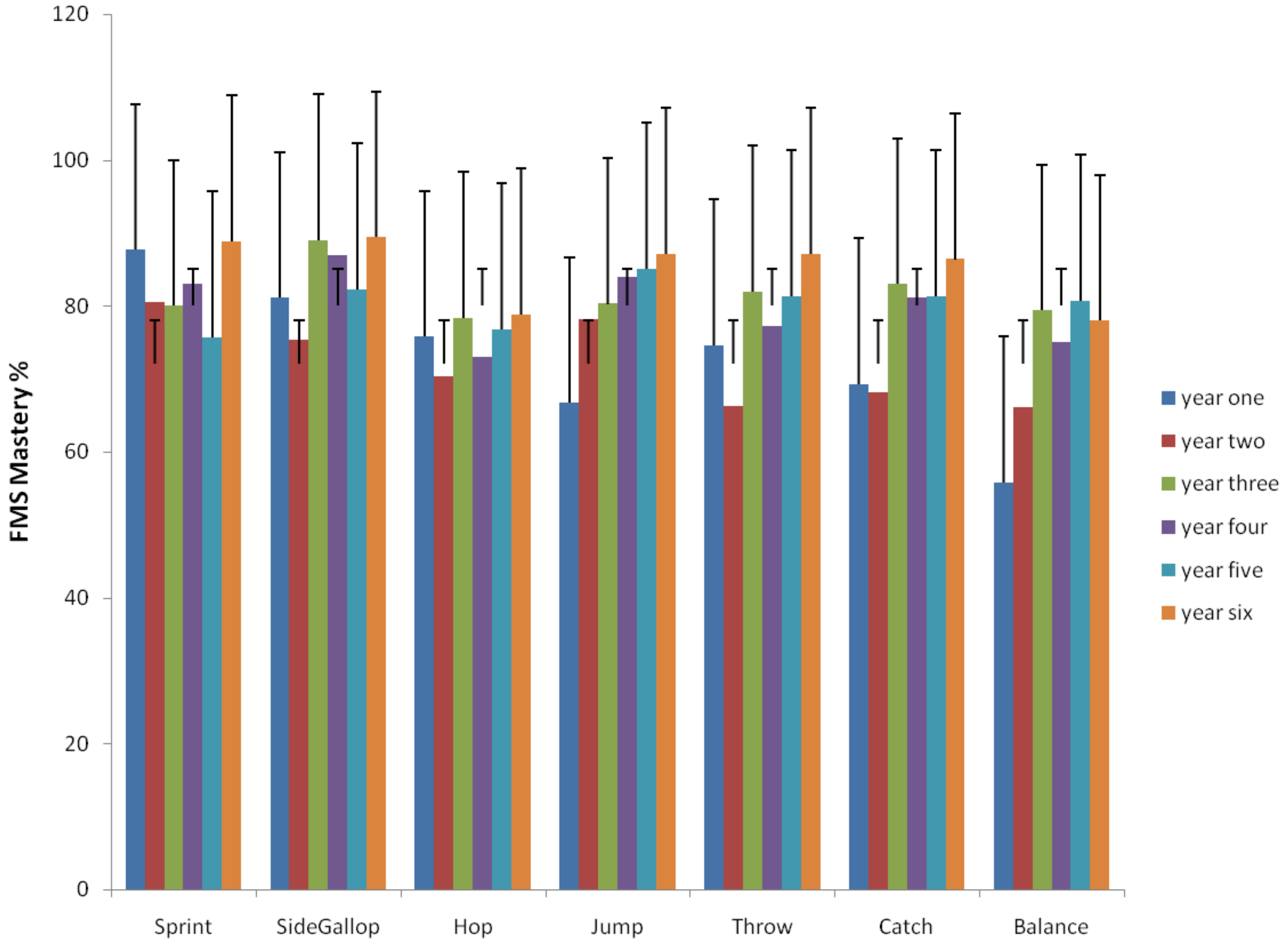

Figure 3.0. Mean ± S.D. for FMS across school Year

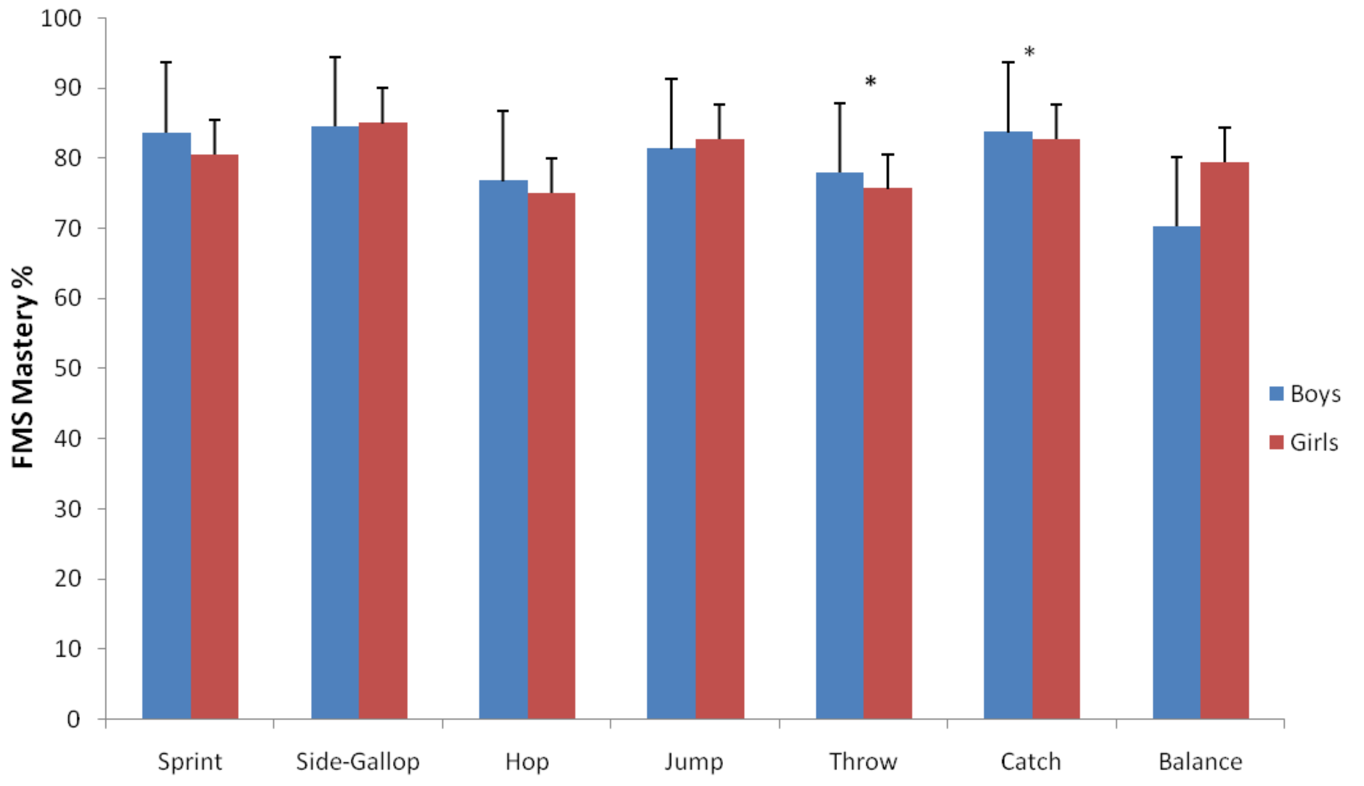

Figure 3.1. Mean ± S.D for FMS across Gender

** represents statistical significance (p = <0.05)*

Results presented in Figure 3.2 show the mean ± S.D for each FMS across weight status (Normal weight, Overweight/Obese). ANOVAs indicated significant weight status main effects for the hop ($F_{1,\ 262}$, 5.483, *p* = .020, Partial eta² = .011) with the normal weight children having significantly greater mastery than the overweight/obese group. The % mastery for each FMS is presented in Table 3.3, which states the Mean ± SD scores for both normal weight and overweight / obese groups.

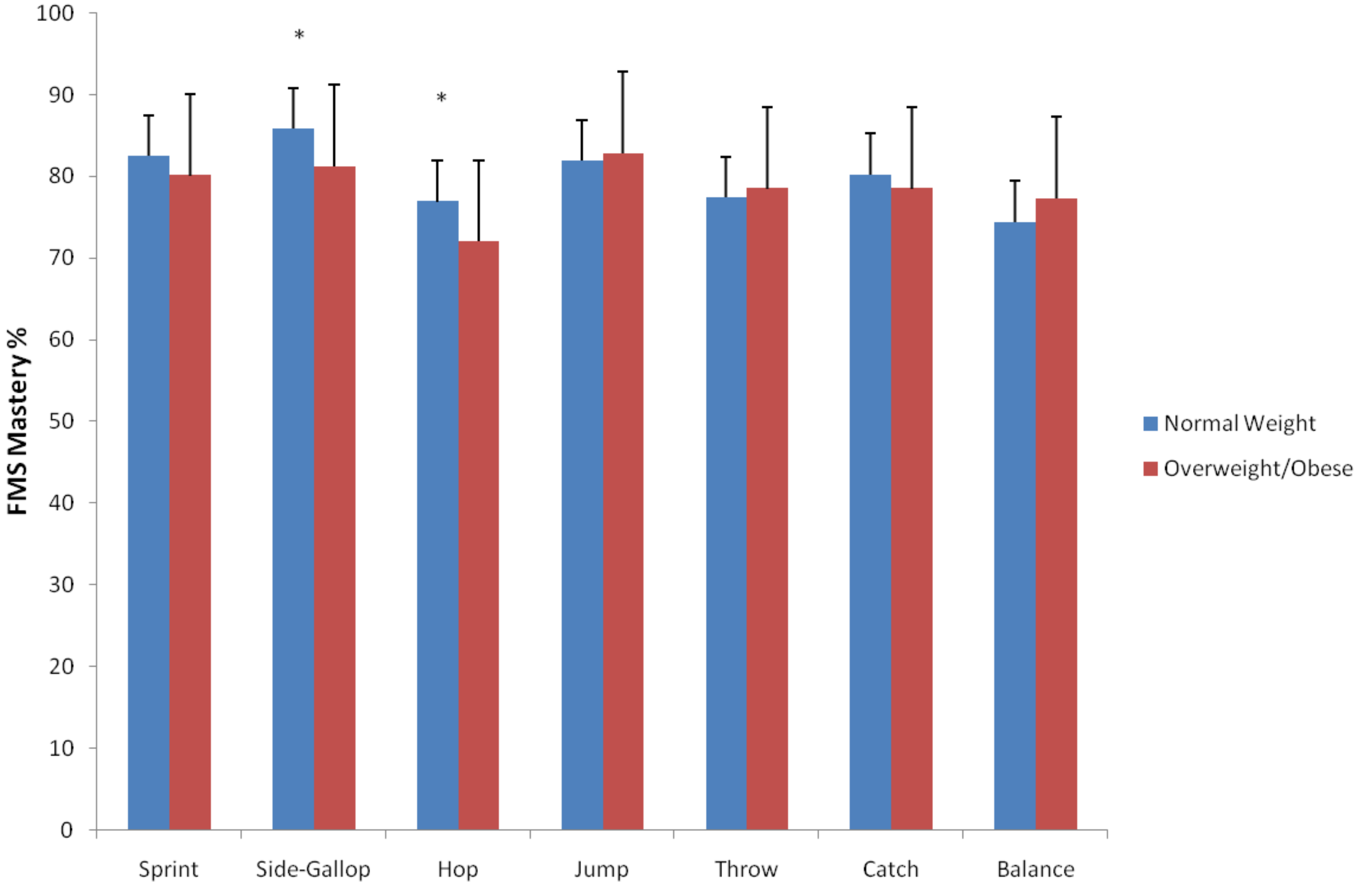

Figure 3.2. Mean ± S.D for FMS across weight status

** represents statistical significance (p = <0.05)*

Results presented in Figure 3.3 illustrate the mean ± S.D for balance mastery both year and gender groups. It is clearly evident that girls have greater balance mastery than boys across each Year group. The results also illustrate that balance mastery significantly increases between Years 1 and 3, yet starts to plateau from Year 3 to Year 6 for both gender groups.

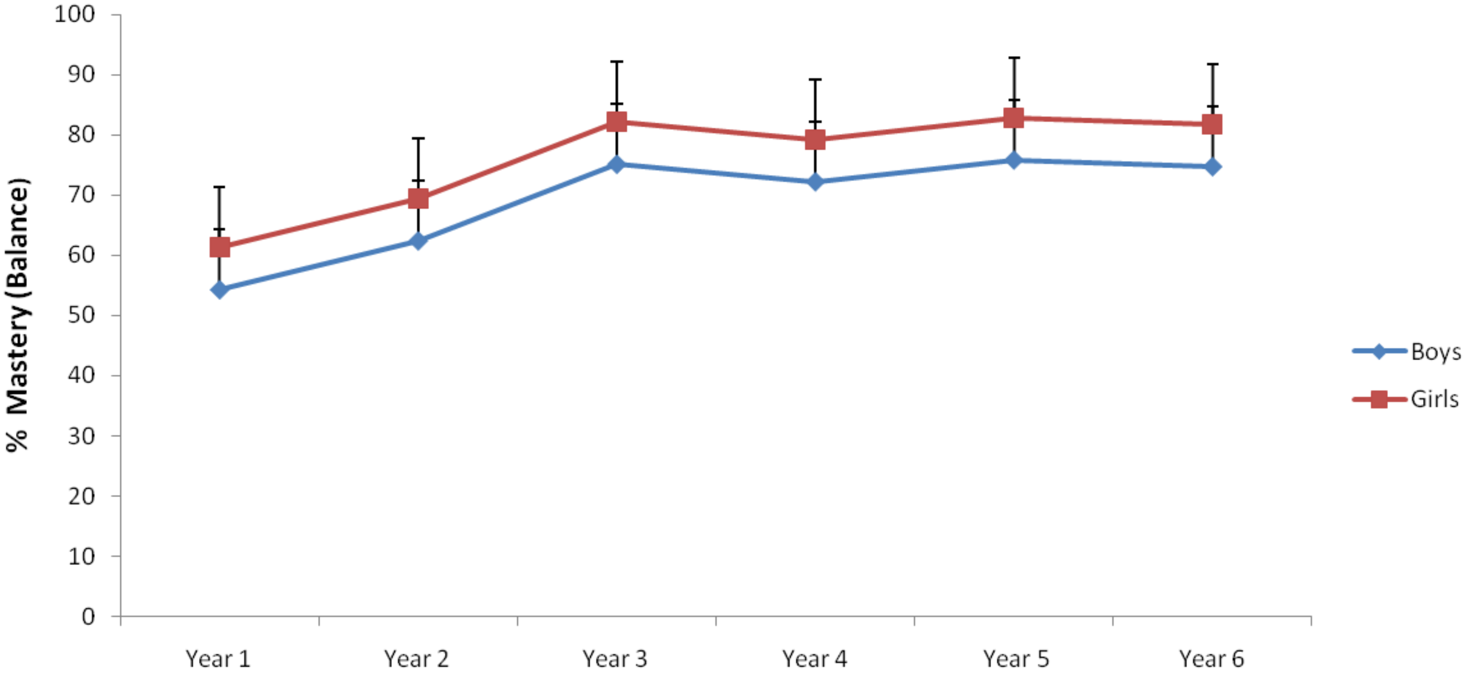

Figure 3.3. Mean ± S.D for Balance Performance across Year Group and Gender

Figure 3.4 presents the mean ± S.D for catch across Year groups and gender. A significant main effect is evident with both school Year and gender, with boys having higher catch mastery over all Year groups than girls ($F_{6,\ 257}$, 9.44, p = .000, Partial eta^2 = .051). Catch mastery progressively increases between Years 1 and 3, yet begins to plateau from Years 3 to Years 6.

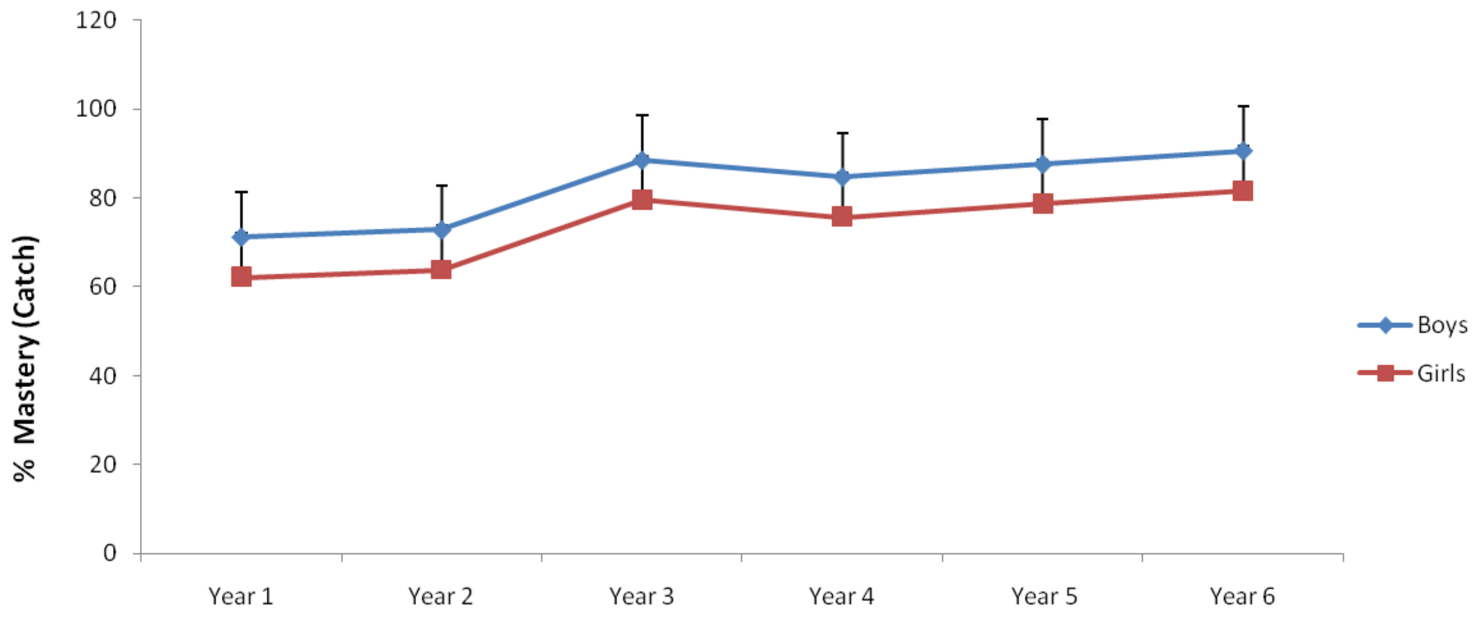

Figure 3.4. Mean ± S.D for Catch Performance across Year Group and Gender

The results presented in Figure 3.5 illustrate sprint mastery across all Year groups 1-6. Data is expressed as Means ± Standard Deviations respectively. It is clearly apparent that the younger age groups achieved higher mastery than the majority of the older Years (refer to the Figure). Results indicated significant main effects amongst Year groups ($F_{5,\ 258}$, 5.52, p = .001).

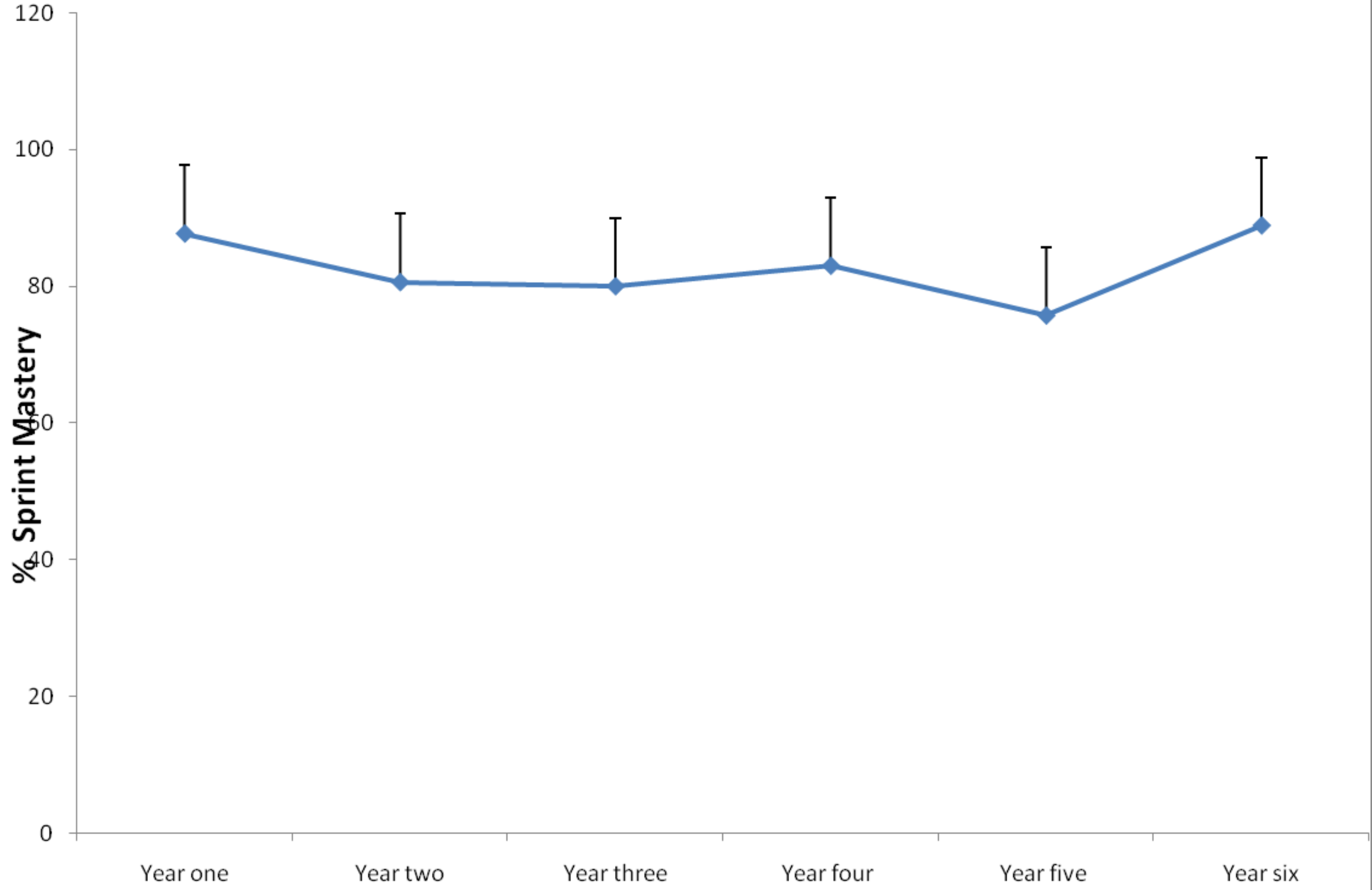

Figure 3.5. Mean ± SD sprint mastery across Year groups (1-6)

Summary of results

In summary, correlations indicated no significant relationships between FMS, PA and BMI. ANOVAs indicated significant gender main effects for balance, throws and catch (all p = <.05), with girls having greater mastery of balance but poorer throw and catch mastery than boys. Significant school year main effects were evident for balance, throws, jumps, sprints, side-gallop and hop (all p = <.05). Bonferonni post hoc tests indicated that in all the FMS, mastery significantly increased from school years 1 and 3 at which point it plateaued from year 3 to 6. Furthermore significant main effects were found in catch mastery, with boys having greater catch mastery over all year groups than girls (p = .001). Significant main effects were also apparent across weight status groups, with normal weight children having higher mastery in the following FMS; side-gallop, hop and catch compared to the overweight / obese group (all p = <.05).

Chapter 4

4.0 Discussion

The current study aimed to examine the relationship between FMS proficiency and habitual PA across school year in a local primary school. The Secondary aims were to look at various correlates such as age, gender and weight status to determine whether there were any differences or associations related to FMS.

4.1 *Gender Differences*

Gender differences were present in both manipulative skills (throw, catch) and postural skills (balance), with boys achieving greater mastery in both throw and catch, but having poorer mastery in balance when compared to girls (see figure 3.2). These results support previous studies that also demonstrated the same trend of results with primary school children (Graf *et al*. 2004; Wrotniak *et al*. 2006; Hume *et al*. 2008). French and Thomas (1985) also support these findings, reporting strong differences between genders and object manipulation skills. Although gender differences in FMS in pre-pubescent children may be mostly attributed to environmental factors (Thomas, 2001); neurological differences between genders is also considered a factor that may have determined these findings. For instance, boys have the hormone testosterone whereas girls have very little testosterone and higher levels of oestrogen (Bellis, 2001). These differences in hormonal structure have considerable effects on brain functioning, for example studies by Bellis (2001) and Thomas (2001) found that having greater levels of testosterone elicits greater spatial ability. Furthermore a study by Janowski (1994) also found that testosterone levels can have a positive effect on spatial cognition therefore boys had performed better in skills requiring the ability to throw and catch. Above all, the brain itself is a powerful machine which can be trained and developed. Therefore, children who practice core tasks such as the FMS carried out in this study can build connections between brain cells and hone new skills through practice during early childhood (Thomas, 2001; Bellis, 2001; Yakovlev, 1967).

Although, neurological differences lie between gender and FMS proficiency (Bellis, 2001) factors of an environmental nature play a big part of skill refinement. Boys in comparison to girls do tend to receive more support and are encouraged to be strong in sport. Previous studies have supported this statement in that boys tend to receive stronger support than girls (Hovell *et al*. 1996; Sallis *et al*. 2000). An example of this would be fathers who strongly believe and strive for their sons to excel in the world of sport therefore continue to push and support them.

This potentially provides boys with more opportunities than girls; therefore future recommendations could be to equally provide gender groups with the same opportunities for instruction, practice, feedback and encouragement (Thomas & French, 1985). Primary school settings would be the ideal location for driving equal opportunities between gender groups, given that PE is a compulsory part of the curriculum and would be a perfect way of equally providing both sexes with the opportunities to develop their physical competence and enjoyment for PA. Furthermore, the likes of after school classes or break time sessions could also help provide that push for active lifestyles across all children.

On the other hand, girls achieved a greater level of mastery in the balance, which has been closely related with results from previous studies (Zuvela *et al*. 2011, Hume *et al*. 2008, and Graf *et al*. 2004). The suggestion that girls tend to withdraw from object manipulation activities such as football, basketball, and cricket may be the reason for these differences. The magnitude of research previously (Williams *et al*. 2008; Lubans *et al*. 2010) has associated girls with activities such as dance or gymnastics. These types of activities require high levels of balance and coordination, which may determine why girls achieved higher balance mastery.

Results in the present study could also suggest that boys are likely to be more active than girls, given that object manipulation type activities (throwing, catching, kicking) have been previously associated with higher activity levels (Raudsepp *et al*. 2006). The assumption that object manipulation skills (catching, throwing) predict subsequent PA is strongly related to the results found by Barnett and colleagues (2009) who suggest this type of skill associates with PA experiences of MVPA intensity. However, the current study did not look at differences in PA; there future studies should look into PA differences across gender groups to determine whether boy and girls differ in levels of PA and whether the types of PA have an effect on the children's PA behaviour.

Furthermore, studies previously have looked at the differences between locomotor and object manipulation skills and found that skills such as throwing and catching take longer to grasp and master in comparison to running or jumping (Okely *et al*. 2004; Van Beurden *et al*. 2002). In the current study mastery in the locomotor skills was relatively equal across boys and girls and no significant main effects were found (results presented in Figure 3.2). From this, it could be suggested that primary school PE lessons should focus on development of object manipulation skills, and if for example children require longer periods of time to master these FMS practical solutions should be looked into, for example workshops during break times, after school workshops or increased community PA looking at FMS development.

4.2 Weight Status Differences

Weight status is a well documented predictor for FMS mastery, and numerous studies have strongly indicated FMS differences between obese children and healthy weight children (Vandaele *et al*. 2011, Fisher *et al*. 2005; Graf *et al* .2004). Development of FMS allows children to independently navigate their environments and contributes to the overall health of children (Piek *et al*. 2008), and without these motor skills children are likely to pursue further physical/sporting activities. The development of FMS could play a pivotal role in the prevention of childhood obesity (Logan *et al*. 2011).

In the present study Pearson Moment correlations indicated significant relationships between BMI and the following FMS; side-gallop, hop, throw and balance (refer to table 3.0). The remaining skills had no significant relationship with BMI (*p*= <.05). These results did support previous findings, given the majority of FMS were inversely related to BMI (Deforche *et al*. 2009; Hume *et al*. 2008; Okely, Chey & Booth, 2004).Previous research (Deforche *et al*. 2009; Okely, Chey & Booth, 2004) support the findings from the current study that looked at FMS differences amongst healthy children and overweight children. The current study strengthens the assumption that overweight children are less proficient in the locomotor skills (side-gallop, hop) and are less proficient in body management skills (balance). Yet, despite these findings, it cannot be concluded why BMI has detrimental effects on the performance of FMS. According to studies by Deforche (2009) and Hume (2008) suggestions have been made that heavier children experience geometry changes, which can have considerable affects to neuromotor development and cause postural constraints.

Using the BMI data, weight status classifications were made using the well established IOTF criteria (Cole *et al*. 2000). Children were grouped into either 1) normal weight children or 2) overweight / obese children. Results from the current study (refer to Figure 3.2) indicated significant weight status main effects for side-gallop, hop and throw (*p* = <.05) respectively. Although ANOVAS indicated significant differences between the mastery of these skills and weight status, percentage mastery for the majority of the FMS on average were very similar (refer to Mean±SD scores presented in Table 3.3). A percentage difference of 2 was found in the sprint, and catch, with a percentage difference of 1 found in the throw and jump. A percentage difference of 3 was found in the balance, with the overweight / obese sample surprisingly achieving higher balance mastery compared to the normal weight sample. Both hop and side-gallop reported a 5 percent difference between weight status groups.

Although Pearson correlations indicated percentage differences, in general terms do these differences prove meaningful? In the majority of skills (sprint, catch, throw, and jump) percentage differences of 1-3% was found (see Table 3.3), with remaining skills (side gallop, hop, and balance) having a percentage difference of 4-5% respectively. Previous studies (Logan *et al*. 2011; Hume *et al*. 2008) reported similar findings amongst skills concluding that a percentage difference of below 3% as too low to prove meaningful. On the other hand, skills with a percentage closer to 5 and above in FMS mastery suggests that more attention to FMS mastery is required, and that children who are not achieving mastery in these skills are more likely to progress and seek more difficult skills in future participation compared to those children not achieving similar mastery in a particular skill.

Overall results did indicate that weight status has a detrimental effect on the performance of FMS, and these results support the study reported by Hume (2008) who also found that weight status is a prime predictor of FMS mastery. More recently a study by Cliff and Okely (2011) assessing movement skill mastery in a sample of clinically overweight / obese children reported FMS deficiencies amongst the sample. Moreover, Cliff and Okely concluded that PA programs designed for children with FMS deficiencies are needed as an overall strategy to promote PA participation.

One of the reasons for the inconclusive findings in this study could be the ratio of normal weight children (78%) to overweight/obese children (22%). Firstly, there were very little obese children (6%); therefore the researcher combined both overweight and obese children into one group. This is a respectable method, and has been used in previous studies (Hume *et al*. 2008; Jones *et al*. 2010; Logan *et al*. 2011a). Secondly, BMI has been questioned as a measure of obesity (Prentice & Jebb, 2001). BMI is only a surrogate of percentage body fat and has been criticised for its misleading impressions of body composition. Furthermore, research by Wells (2000) has suggested BMI as a poor measure of obesity especially in children, given the variations children experience in the timing of puberty. Therefore future research should maybe focus on techniques such as skinfold measurement, hydrostatic weighing or air displacement plethysmography to be more accurate in determining the weight status of both children and adolescents (Prentice & Jebb, 2001). Despite, the controversy over measurements of obesity, BMI was the chosen measurement on the grounds that the advantages outweighed the disadvantages (Prentice & Jebb, 2001; Dietz *et al*. 2001).

4.3 Age group differences

Consistent findings have indicated that PA declines with age, which potentially leaves high concerns for the health and fitness of future children and adolescents (Vandaele *et al*. 2011; Barnett *et al*. 2009, Okely & Booth, 2004). In the present study ANOVAS indicated significant School Year main effects in the following skills (side-gallop, jump, balance, hop and throw (all p = <.05, see Figure 3.0).

Significant main effects were also identified in sprint amongst Years 1, 3 and 6 (all p = <.05). Bonferroni post hoc tests further indicated that with all FMS, mastery significantly increased between Years 1 and 3 at which point FMS mastery plateaued between Years 3 and 6 respectively. Hypothetically, these results are suggesting there is a plateau in the learning and performance curves for FMS mastery (Schmidt, 2008).

Performance curves are used to depict acquisition of a skill and describe the process of an individual over time. There are generally two patterns associated with the performance curve theory; 1) upwards slope if measured data improves with learning and 2) downwards slope if the measured data decreases with learning. In the current study, results indicated a plateau in FMS mastery between Years 3 and 6, suggesting performance decreased with learning (Schmidt, 2008). However, research (Schmidt, 2008) have speculated that the early stages of learning show the fastest rate of performance and is slowest as individuals approach limits of their ability. Nevertheless, practical solutions should be put in place to help prevent these plateaus in performance, so all children continue to develop their movement skills through subsequent years (Robinson *et al*. 2011).

Previous research with Australian children (Lubans *et al*. 2010; Barnett *et al*. 2009) have supported the findings in the present study and documented increased FMS mastery in School Years 1-4 with a subsequent plateau in FMS between Years 4 and 6. Research by

Okely and Booth (2004) also support these findings, which found very little development in FMS from Years 4-6. Although the majority of children master these FMS throughout primary school, there are a significant proportion of children not achieving full mastery of FMS by school year 6. This is important, as FMS mastery is likely to lead to increased levels of lifelong PA (Vandaele *et al*. 2011, Lubans *et al*. 2010). FMS are the skills needed to allow children to fit into the school environment, and are the foundation for participation in further activities (Robinson *et al*. 2011).

Primary Schools and PE specialists are the catalysts to introduce and develop these FMS (Olrich, 2002); therefore schools should look to focus more on FMS in PE lessons in all School Years. This way, FMS is kept consistent and children are likely to be equipped with the skills required prior to leaving school.

From a research standpoint, it is important to continue to determine the most effective solutions to helping children keep active and FMS development is an important stepping stone for PE specialists to look at (Logan *et al*. 2011; Robinson *et al.* 2011). Although the current study don't support this, age group differences are important. This is because all children acquire these skills to progress and hopefully continue participation in physical activities (Okely & Booth, 2005; Lubans *et al*. 2010). FMS don't develop naturally through maturational processes, these skills need to be learned, practised and reinforced (Robinson *et al*. 2011) and it is the educators and PE specialists who should target sessions with the aim to help children achieve full mastery of these skills (Okely & Booth, 2004). The majority of primary schools currently lack a systematic approach for developing FMS and fitness concepts that prepare children to enjoy being active and equip them with the necessary skills to enjoy physical activities (Guedes, 2007). It is therefore, a necessity for PE to be made a pedagogical approach to help improve the delivery of FMS in schools and educate all children, parents and administrators (Guedes, 2007).

It is well documented that mastery of FMS improves one's self efficacy, which as a result will provide children with the self-confidence to seek more difficult tasks and try new activities (Bandura, 2001). The term self-efficacy refers to one's self belief in their capabilities to organise and execute a specific task successfully. Performing a task successfully increases one's self confidence, elevates positive thoughts and beliefs in their performance (Bandura, 2001; Bandura, 1977). On the other hand, those who don't master a specific task are more likely to experience low self-efficacy. Low self-efficacy lowers one's self confidence; those who lack self confidence in their ability are more likely to withdraw from more difficult tasks and sports, given they have the belief that these tasks are far beyond their capabilities. In the current study, although differences were found, results remain inconclusive.

One's self perception in their ability is an important factor in developing mastery of tasks (Logan *et al*. 2011; Bandura, 2001) and it could be suggested that the sample tested in the present study experienced low self-efficacy, especially since FMS experienced a plateau in performance from year's 3-6 respectively. Future research could possibly look into the relationship between self-perception/self-efficacy and FMS performance to distinguish whether one's self perception in their ability has an effect on the performance of FMS.

Interestingly in the present study Year 1 children achieved higher sprint mastery than subsequent Years (2, 3, 4 and 5). Results are presented in Figure 3.5. Significant age group main effects were found with Year 1 and 3 (p = <.05). This is an unexpected finding because it seems intuitive that a lower Year group achieved higher sprint mastery than the higher Year groups. However, these results may have been due to several factors; the sample selected and the time of data collection. At the time of testing Year 1 and 2 children had just finished a block of PE teaching that had been led by the City's PE Specialist and had focussed on speed, agility and quickness (SAQ) training. Therefore, we need to be careful about inferring conclusions from Year 1 and 2 in the current study to the wider population.

In this study the researcher focussed on using Year group rather than date of birth which may have possibly played part to the skewed data present. Focussing on Year group may have limited results found between FMS and age, given researchers have explored the differences between those born between the months of September and December and those born between the months of January and august; finding out that those born during the later months (September – December) to be more equipped with necessary skills needed for sport in comparison to those born in the earlier months of the year. Although using date of birth rather than Year group may have provided clearer findings between age and FMS; the study was funded through the Coventry City Council and there was no place for the researcher to decide how the study will be set.

4.4 The relationship between FMS and Habitual PA

The primary aim of this study was to explore the relationship between FMS and PA levels of children. Consistent research has looked at the effects of achieving FMS mastery on subsequent lifelong PA benefits (Wrotniak *et al*. 2006; Reed *et al*. 2004) and it is clear to say that FMS is likely to have positive effects on future participation in sport and physical activities. However, these findings are inconclusive and only weak-moderate relationships have been found with these two variables (Vandaele *et al*. 2011; Zuvela *et al*. 2011; Fisher *et al*. 2005). These findings support the present study, as there was no significant relationship between habitual PA and FMS ($p = <.05$, refer to Table 3.0), and all Pearson-moment correlations indicated weak relationships between the two.

It could be suggested that these results may in fact have a stronger relationship than shown, given the sample size used in this study (Duncan *et al*. 2007). Furthermore prior to analysing the results pedometers which was the chosen method of collecting PA was not without its limitations. Equipment failure and equipment loss were the two biggest limitations with this study, whereby the researcher was repeatedly returning to the school to make sure children recorded four days of PA (Thursday, Friday, Saturday, Sunday). Furthermore, the pedometers did tend to modify the subjects behaviour during the data collection months. The constant reminder that these devices were assessing their PA status could have affected the way the children normally participate in physical activities (Ridgers *et al*. 2006). Although a non-significant relationship was found between FMS and PA, results from this current study along with previous studies suggest that children equipped with FMS are potentially more likely to continue to be active and seek wider opportunities to be physically active.

How important are these results and are they practical? This is a common question in research and the practical significance implies the view of having importance and some practical use in the real world. In this study Partial eta² was used as the measure of effect size. The effect size gives you an indication of the effect of one variable on another rather the P value which only indicates whether or not they are significantly different due to chance. In the current study there were significant differences amongst gender and FMS performance, however, the effect size was small so in practical terms this differences may not have a meaningful impact on the performance of FMS between boys and girls. Significant differences were also present with FMS (sprint, side- gallop, jump, throw, and balance) and Year group, but the effect sizes were larger, so in practical terms these differences would have a higher meaningful impact on FMS performance.

4.5 Major Limitations and directions for future research

There were a number of methodological limitations to consider this study. Firstly, because of the cross sectional design and the correlational nature of the study no statements can be made about causality regarding PA and FMS. Secondly, there were limitations with the instrumentation, whereby pedometers were the chosen method to measure PA. These devices are a widely used tool to assess PA in children and adolescents (Duncan *et al* .2007) due to their simplistic nature, validity and level of repeatability. Nevertheless, these devices do not measure the intensity of PA, therefore the use of tri-axial accelerometers could provide a more precise measure of PA with both the variation of intensity and duration spent being active.

A significant reduction in the number of subjects was caused by the low compliance of children and parents with the pedometer use and data recording. Thirdly, the time data was collected caused surprising results in some of the FMS. Both Year's 1 and 2 children went through a period of SAQ training prior to testing, as a result helped the lower Year's achieve greater mastery in the locomotor skills. Instrumentation used to assess weight status was a limitation within the study. BMI is the most simple and desirable instrument used when assessing younger children, however is only a surrogate of percentage body fat and has been criticised for its misleading impressions of body composition. To determine more accurate readings research efforts should focus on using more accurate techniques such as skinfold measurements, hydrostatic weighing or air displacement plethysmography (Prentice & Jebb, 2001).

Possible limitations for the study may have been due to skewed data than may have arisen from the percentage of children whose parents did not agree to them taking part in the investigation. Reasons for their withdrawal the researcher did not know, but these may have occurred due to religious beliefs or the generally that parents felt the children would not have gained anything from being part of the project undertaken. Furthermore, in the study there were a higher number of girls to boys in each of the Year groups which may have been a possible cause of variance in the data. Also, amongst the overweight group, there were more females present compared to boys which may have also caused potential skew in the data.

Limitations were also present in the marking criterion used to measure % mastery. Although previous studies (Williams *et al*. 2008; Van Beurden *et al*. 2002) have documented the strengths of this method there are some weaknesses in the marking criteria itself. When analysing the video clips for each of the FMS, it was difficult at times to determine whether or not children were successfully completing a particular component of a skill. For some skills, one component actually covered two components; therefore it was difficult to decide on whether children successfully completed certain components of that particular skill (see appendix 1).

To date, few studies have been conducted to measure the relationship between 'habitual' PA and FMS in primary school children.

These studies have yet to conclude whether there is a relationship between the two variables and if so to what degree is the strength of the relationship. To better clarify the area surrounding FMS and PA research efforts must be extended. Longitudinal and intervention studies would provide a clearer insight to the nature of the relationship of the various correlates that influence PA in children and adolescents. This research study in combination with other related studies provides support for the relationship between FMS and PA. These data reinforces the importance of FMS and the claim that improvement in these skills may directly and indirectly improve PA behaviour (Lubans *et al*. 2010). Furthermore, higher FMS proficiency may subsequently lead to greater success in physical activities and enable children to seek opportunities to be physically active (Robinson *et al*. 2011, Lubans *et al*. 2010).

The development of FMS may indirectly affect the PA behaviour of children with the influence of perception of competence (Okely, Booth and Chey, 2004; Bandura, 2001). One's belief in their ability to successfully perform specific skills is very important and research has previously reported perceived competence as a strong predictor of FMS proficiency and subsequent PA, however studies have yet to conclude this (Logan *et al*. 2011; Bandura, 2001). In relation to the current study, perceived competence was not assessed; future research looking at the association between perceived competence, FMS and PA would help clarify whether perceived competence is a strong moderator of FMS proficiency and subsequent PA in children.

4.6 Conclusions

In conclusion, the findings of the present study indicated a non-significant relationship between FMS and habitual PA. The strength of this relationship was particularly weak, supporting previous studies that reported a weak-moderate relationship. The hypothesis that there is a relationship between total FMS and PA was refuted with the results of this study. If there is no relationship between these variables, are researchers going about it the wrong way, or maybe researchers are assuming because FMKS leads to greater competency for future PA, it should be related to current PA. It could be that there is no need for PA tracking and longitudinal studies to determine this.

Overall statistics indicated a progressive increase in FMS mastery from Year's 1-3, at which point mastery plateaued between Year's 3 and 6. Higher manipulative skills proficiency was found in males, supporting the hypotheses of this study. On the other hand, girls performed better at the locomotor skills compared to boys. These findings are of extreme importance to physical education teachers, practitioners and sport scientists. The physical education classes are potentially one of the most conducive environments for children to learn and develop these skills; therefore schools should look to focus physical education lessons on mastering these skills. Additionally if manipulative skills are a determinant of habitual PA, it is plausible to say that physical educators should reinforce learning of object manipulation skills in the PE curriculum of primary school children, particularly girls whom tend to achieve lower mastery compared to boys. Community based PA programs should also incorporate object manipulative activities to as one of the components for seeking increased PA levels in children.

Statistics also indicated significant weight status main effects amongst skills, with the majority of skills being dominated by the healthier weight children. These findings, support previous research looking at the weight status and FMS proficiency (Lubans *et al*. 2011;

Hume *et al*. 2008). Improvements are needed to provide better opportunities for children in the PA domain. Programs focussing on improving FMS in schools may provide a pivotal role in childhood obesity.

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List of Appendices

INFORMED CONSENT FORM
COVENTRY UNIVERSITY

NAME OF RESEARCHER: Luke Carl Baker (Masters by Research Student)
NAME OF UNIVERSITY SUPERVISOR: Dr. Sam Birch (Senior Lecturer in Applied Physiology, Department of Biomolecular and Sport Sciences)
KEY PARTNERS: Physical Activity and Physical Education project (Children, Learning and Young People's Services directorate)

PROJECT TITLE: The assessment of Fundamental Movement Skills and habitual physical activity levels in primary school children.

PURPOSE OF THE RESEARCH:
To assess 7 fundamental movement skills (sprint, side-gallop, hop, jump, balance, throwing and catching) in primary school children. To investigate age group differences, gender differences and weight status (classified as overweight/obese or normal/healthy weight) and their ability to perform these skills. To assess habitual physical activity using a step count pedometer to determine how active your child is over a four day period (two week days, and weekends). This data will then be used to assess whether habitual physical activity determines the performance of the fundamental movement skills.
We will also look at the relationship between subjective and objective measures for each of movement skills and see whether the technique (subjective) influences the performance (objective) of each of these skills.

PARTICIPATION IN THIS RESEARCH WILL INVOLVE:
If you agree for your child to take part in this study, your child will be involved in a number of practical sessions which will take part at their school during normal PE lessons. Children who have been involved with this study previously have found it exciting and an enjoyable experience.

Prior to testing, heart rate measurements will be recorded, your child will be asked to lie down for ten minutes at rest with a heart rate monitor to test their heart health.

During the first session, height and weight will be measured confidentially, followed by a 10 metre running sprint, a 5 metre hop and a 5 metre side gallop on a measured track. During the second session your Child will be asked to throw and catch a soft ball, jump as high as possible and balance on one leg for 20 seconds (standing still) and then stand on a balance board for 20 seconds. Each skill will be demonstrated to the children before they have a go, they will then perform each skill three times and this will be video recorded for analysis purposes. This will run over a two week period and will form the content for your child/children's PE lessons.

Habitual physical activity ('everyday activity') will be assessed using a step count pedometer, which will be worn from the time your child has got up in the morning and throughout the day until bed time. This will be carried out over a four day period, which will consist of two days in the week and both days on the weekend. Step counts will be recorded by the parent/guardian and used for analysis purposes.

All data will remain confidential. Each child will be given a code (number) and their names will not be traced back to the results following the collection of data. All data and the videos will be securely locked away in a filing cabinet in the project supervisor's office. The researcher and supervisor are both fully CRB checked and have worked with children in a number of settings for many years.

If you agree for your child to take part in this study, please ensure that your child wears appropriate comfortable clothing (PE kit) and suitable footwear (trainers/ pumps) on the days of participation in the sessions and eats a suitable breakfast prior to the PE lessons.
The project team will be involved in briefing the Class teachers and Head Teacher on the details of the study so that parents can ask any questions they may have. If they can not answer your questions you can contact the project supervisor directly (details below).

You may withdraw your consent at any time throughout the project without giving a reason. Your child will only be involved if they also agree to do so. Under no circumstances will your child be asked to participate in the study if they do not wish to and if we do not receive a signed form from you.

FORESEEABLE RISKS OR DISCOMFORTS:
As with any type of exercise there is always a slight risk of tripping over, muscle soreness/discomfort from the exercises/ skills performed. However, a thorough warm up will take place before the exercises start to reduce this risk. A full demonstration of each exercise will be carried out before your child attempts the skills for themselves, this should also help to clarify any uncertainties and reduce risk of injury through bad technique. Furthermore, all equipment will be kept tidy and away from the children where possible at all times to avoid tripping over.

BENEFITS TO THE SUBJECT OF PARTICIPATION:
The children will hopefully find the study an enjoyable experience and the data collected may be used as part of a larger study which could improve PE lessons in primary schools in the future.

WHAT WILL HAPPEN TO YOUR DATA:
Any data/ results from your participation in the study will be used by Luke Carl Baker as part of his Master's by research degree. The data will also be available to the project team and may be published in scientific works, but your Childs identity will never be revealed. All data will be securely locked away in a filing cabinet and all subjects will be given a code for confidentiality purposes. Data that is stored electronically will use subject codes so that individuals cannot be identified with only the project team being able to access these results. Videos will be locked away and only viewed by members of the project team and will be disposed of in confidential waste once finished with. The data is likely to contribute to further research collected by the project team in this area over the next 3-5 years.

If you have any questions or queries please do not hesitate to contact your child's class teacher who will be happy to answer any questions you may have. If they cannot help you, you can contact Dr Samantha Birch (supervisor) at s.birch@coventry.ac.uk or Luke Carl Baker (Master's by research student) at bakerl5@coventry.ac.uk. Alternatively you can phone Samantha Birch on 024 7688 8559.

If you have any questions about your childs rights as a participant or feel your child is being or has been placed at risk during the study you can contact the Head of Department at Coventry University (Dr Val Cox on 024 7688 8323) or Ken Adamson (Advisory teacher PE, 024 7652 7427).

I confirm that I have read the above information. The nature, demands and risks of the project have been explained to me and I will explain them to my child/children.

There will be no benefits/ payments for your Childs participation in this study.

I knowingly assume the risks involved and understand that my child or I may withdraw our consent and discontinue participation at any time without question.

Parent's/ Guardian's signature: .... Date: ....

Researcher's signature: .... Date: ....

The signed copy of this form is retained by the researcher, and at the end of the project passed on to the supervisor. This will be locked away in a filing cabinet.

Name of child: ....

School year: ....

Date of Birth: ....

Gender: ....

Ethnic group: ....

☺ Thank you for agreeing for your child to take part, we hope that they enjoy being a part of the study ☺

Medium to High Risk Research Ethics Approval
Read this first

Who should use this checklist?

You should only use this checklist if you are carrying out research or consultancy project through Coventry University: This includes:

- Members of academic, research or consultancy staff.
- Honorary and external members of staff.
- **Research degree students (MA/MSc by Research, MPhil or PhD).**
- Professional degree students (EdD, EngD, DClinPsyc, DBA etc).
- Undergraduate students who have been directed to complete this checklist.
- Taught postgraduate students who have been directed to complete this checklist.

Who should not use this checklist?

You should not use this checklist if you are:

- An undergraduate student (Use the low risk ethics approval checklist first).
- A taught postgraduate student (Use the low risk ethics approval checklist first).
- A member of staff evaluating service level quality (Use the low risk ethic approval checklist first)
- Carrying out medical research or consultancy involving the NHS (Use the NHS online Research Ethics Committee approval form).

Can I begin work before the project is ethically approved?

No. Primary data collection can not begin until you have approval from one of the following:

- The University Applied Research Committee (UARC)
- The Research Degrees Sub-Committee (RDSC)
- An External Research Ethics Committee (NHS Research Ethics Committee, Lead Partner University etc)

Alternatively, if you have established that your project does not require ethical approval using:

- Low Risk Ethical Approval Checklist
- Medium to High Risk Research Ethics Approval Checklist

What will happen if I proceed without approval or falsely self-certify research ethics approval?

Collecting primary data in the absence of ethical approval or falsely self-certifying the level of risk associated with a project will constitute a **disciplinary offence**.

- For **Students** – this means disciplinary action resulting in immediate failure in any module or project associated with the research and potentially dismissal from the University.
- For **Staff** – This means disciplinary action, which may potentially lead to dismissal.

If you do not have ethical approval, the University's insurers will not cover you for legal action or claims for injury. In addition, you may be debarred from membership of some professional or statutory bodies and excluded from applying for some types of employment or research funding opportunities.

What happens if the project changes after approval?

If after receiving ethical approval your project changes such that the information provided in this checklist is no longer accurate, then the ethical approval is automatically suspended.

You must re-apply for ethical approval immediately and stop research based on the suspended ethical approval.

What about multi-stage projects?

If you are working on a project which involves multi-stage research, such as a focus group that informs the design of a questionnaire, you need to describe the process and focus on what you know and the most risky elements. If the focus group radically changes the method you are using then you need to re-apply for the ethical approval.

Is there any help available to complete this checklist?

Guidance can be found in the ethics section of the Registry Research Unit Intranet. You will find documents dealing with specific issues in research ethics and examples of participant information leaflets and informed consent forms. Further advice is also available from:

- Director of Studies (Students)
- Faculty Research Ethics Leader (Academic Staff)
- Registry Research Unit (Students and Staff)

Which sections of the checklist should I complete?

<table>
<tr><th>If your project involves:</th><th>Please complete sections</th></tr>
<tr><td>Desk-research only, using only secondary or published sources.</td><td>1, 2 and 16</td></tr>
<tr><td>An application to an External Research Ethics Committee other than the NHS.</td><td>1 to 4 and 16</td></tr>
<tr><td>Collection and/or analysis of primary, unpublished data from, or about, identifiable, living humans (either in laboratory or in non-laboratory settings).</td><td rowspan="4">1 to 15 and 16</td></tr>
<tr><td>Collection and/or analysis of data about the behaviour of humans in situations where they might reasonably expect their behaviour not to be observed or recorded.</td></tr>
<tr><td>Collection and/or analysis of primary, unpublished data from, or about, people who have recently died.</td></tr>
<tr><td>Collection and/or analysis of primary, unpublished data from, or about, existing agencies or organisations.</td></tr>
<tr><td>Investigation of wildlife in its natural habitat.</td><td>1 to 5, 15 and 16</td></tr>
<tr><td>Research with animals other than in their natural settings.</td><td rowspan="2">Do not complete this checklist. Contact the Registry Research Unit for advice</td></tr>
<tr><td>Research with human tissues or body fluids.</td></tr>
<tr><td>Research involving access to NHS patients, staff, facilities or research which requires access to participants who are mentally incapacitated.</td><td>Do not complete this checklist. Make an application using the on-line NHS Research Ethics Committee approval form</td></tr>
</table>

How much details do I need to give in the checklist?

Please keep the details as brief as possible but you need to provide sufficient information for peer reviewers from the Research Ethics Panel to review the ethical aspects of your project.

Who are the Faculty Research Ethics Leaders?

Check the Registry Research Unit Intranet site for the most up to date list of Faculty Research Ethics Leaders.

How long will it take to carry out the review?

If your project requires **ethical peer review** you should submit this to the Registry Research Unit at **least three** months before the proposed start date of your project.

How do I submit this checklist?

The completed checklist and any attachments must be submitted to ethics@coventry.ac.uk

Medium to High Risk Research Ethics Approval Checklist

1 Project Information (Everyone)

Title of Project: **Fundamental Movement skill 'Mastery' and Habitual Physical Activity In Primary School Children years 1-6.**
Name of Principal Investigator (PI) or Research or Professional Degree Student: **Mr Luke Carl Baker**
Faculty, Department or Institute: **Faculty of Health & Life Sciences, Department of Bimolecular and Sport Sciences.**
Names of Co-investigators (CIs) and their organisational affiliation
How many additional research staff will be employed on the project? Names and their organisational affiliation (if known)
Proposed project start date (At least three months in the future) **January 2011**
Estimated project end date **16th September 2011**
Who is funding the project? Education and Learning Services Children, Learning & Young People's Directorate Coventry City Council Has funding been confirmed? **Yes**
Code of ethical practice and conduct most relevant to your project: • British Computer Society • British Psychological Society • Engineering Council • Social Research Association • Socio-legal Studies Association • Other (Specify) • **British Association Of Sport and Exercise Sciences (BASES, 2000)**

Students Only

Degree being studied (MSc/MA by Research, MPhil, PhD, EngD, etc) **MSC by Research**
Name of your Director of Studies: **Dr Sam Birch**
Date of Enrolment: **October 2010**

2. Does this project need ethical approval?

Questions	**Yes**	**No**
Does the project involve collecting primary data from, or about, living human beings?	x	
Does the project involve analysing primary or unpublished data from, or about, living human beings?	x	
Does the project involve collecting or analysing primary or unpublished data about people who have recently died other than data that are already in the public domain?		x
Does the project involve collecting or analysing primary or unpublished data about or from organisations or agencies of any kind other than data that are already in the public domain?		x
Does the project involve research with non-human vertebrates in their natural settings or behavioural work involving invertebrate species not covered by the Animals Scientific Procedures Act (1986)?[1]		x
Does the project place the participants or the researchers in a dangerous environment, risk of physical harm, psychological or emotional distress?		x
Does the nature of the project place the participant or researchers in a situation where they are at risk of investigation by the police or security services?		x

If you answered **Yes** to **any** of these questions, proceed to **Section 3**.

If you answered **No** to **all** these questions:

- You **do not** need to submit your project for peer ethical review and ethical approval.
- You should sign the Declaration in **Section 16** and keep a copy for your own records.
- Students must ask their Director of Studies to countersign the declaration and they should send a copy for your file to the Registry Research Unit.

[1] The Animals Scientific Procedures Act (1986) was amended in 1993. As a result the common octopus (*Octopus vulgaris*), as an invertebrate species, is now covered by the act.

3 Does the project require Criminal Records Bureau checks?

Questions	Yes	No
Does the project involve direct contact by any member of the research team with children or young people under 18 years of age?	x	
Does the project involve direct contact by any member of the research team with adults who have learning difficulties?		x
Does the project involve direct contact by any member of the research team with adults who are infirm or physically disabled?		x
Does the project involve direct contact by any member of the research team with adults who are resident in social care or medical establishments?		x
Does the project involve direct contact by any member of the research team with adults in the custody of the criminal justice system?		x
Has a Criminal Records Bureau (CRB) check been stipulated as a condition of access to any source of data required for the project?	x	

If you answered **Yes** to **any** of these questions, please:

- Explain the nature of the contact required and the circumstances in which contact will be made during the project.

The nature of the project involves primary school children participating in a number of Fundamental Movement Skills (throwing, catching, hopping, side galloping, running, balancing and jumping) during normal PE lessons and wearing physical activity monitors (pedometers) for 4 days to allow us to investigate the relationship between physical activity levels and fundamental movement skills.

The children will perform each of the seven skills 3 times and they will be video recorded doing so for subsequent analysis of each skill. The researcher will carry out the video analysis in a quiet computer laboratory, where no other individuals will be present. The videos will be compared against New South Wales criteria (2000) to assess each child's mastery of fundamental movement skills.

A full CRB check has been carried out on the principal researcher prior to enrolling for this degree. Coventry University are currently carrying out their own CRB check also. The video clips will be locked away in the project supervisors filing cabinet and will remain private and confidential at all times.

4 Is this project liable to scrutiny by external ethical review arrangements?

Questions	Yes	No
Has a favourable ethical opinion been given for this project by an external research ethics committee (e.g. social care, NHS or another University)?		x
Will this project be submitted for ethical approval to an external research ethics committee (e.g. social care, NHS or another University)?		x

If you answered **No** to **both** of these questions, please proceed to **Section 5**.

If you answered **Yes** to **either** of these questions:

- Sign the Declaration in **Section 16** and send a copy to the Registry Research Unit.
- Students must get their Director of Studies to countersign the checklist before submitting it.

5 More detail about the project

What are the aims and objectives of the project?

Aims

The purpose of this study is to determine whether FMS ability correlates with the physical activity levels of children. The secondary aims of this study will be to assess both age group and gender differences for each of the motor skills and physical activity levels. Additionally both subjective and objective measures will be correlated to find any relationships between each of the motor skills.

Objectives

Assess seven Fundamental Movement Skills (Sprint, Hop, Side-gallop, Jump, Balance, Throw and Catch) using both subjective (video analysis of each skill) and objective measures. The objective measures proposed are; 10m sprint time (to assess running speed) using Smartspeed timing gates (SMARTSPEED, UK), lateral balance stability over 20 seconds using a stabilometer (SMT, Tunturi, UK) (Birch et al., 2010), jump height and leg power using a counter movement jump performed on a smartspeed jump mat (SMARTSPEED, UK).

Habitual Physical Activity will be measured using step count pedometers (Yamax Digiwalker) over a four day period, consisting of two weekdays and weekends. The child's parents will be asked to note down their child's step count at the end of each day (see attached form).

FMS performance will be analysed using video analysis software (Quintic, UK) and each video clip will be marked against NSW (2000) criteria for mastery of fundamental movement skills.
The data from the objective measures will be downloaded into Microsoft excel from smartspeed PDA and SMT balance software.

The Statistical analysis package SPSS PAW 17.0 will be used to statistically analyse the data.

Briefly describe the principal methods, the sources of data or evidence to be used and the number and type of research participants who will be recruited to the project.

Methods

Following Coventry University Ethics Committee approval, informed consent (see attached) will be issued to six local primary schools in the Coventry Region. The funder of this project has contacted the schools already and the project has been agreed by Head teachers at each school. The desired subject number recruited will be 600 children ranging from year's 1-6 respectively. Parents will be asked to sign and return the forms to their child's class teacher. Only children with signed consent forms from the parents and who give assent themselves to take part will be recruited for the study. Under no circumstances will a child be made to participate in the study if they do not wish to, even if their parents have signed to say that they can.

Inclusion criteria for the participants will be for each child to be healthy and free of illness on the day of testing and free from injury. All testing will be carried out in school hours, during PE sessions, alongside a PE specialist (who works for the Education and Learning Services Children, Learning & Young People's Directorate, Coventry City Council and is a member of staff at Coundon primary school).

All subjects and parents/guardians must complete the informed consent provided before taking part in the study. Prior to assessing the skills a thorough warm up consisting of 10 minutes of pulse raising activity and dynamic exercises will be carried out by the PE

specialist. This will be to minimise any risk of injury to the children. Height (cm) and mass (kg) will be calculated and used to determine each of the children's body mass index (BMI / weight/height^2). Seven Fundamental Movement Skills (sprint, hop, side-gallop, jump, catch, throw and balance) be will assessed using video analysis. A 10m marked track will be used for the sprint, hop and side-gallop and a Smartspeed timing gate system (SMARTSPEED, UK) will be used to measure sprint times only for each of the participants. The jump will be performed using a jump mat (SMARTSPEED, UK), and the balance will be performed using a balance board/ stabilometer (Tunturi, UK). Throwing will be carried out using a target which will be placed on the sports hall wall 5m away from the child, we will only be looking at video analysis/technique of the throw, not accuracy. Catching will be carried out in a large space at the back of the sports hall, where the PE specialist will throw a soft ball to each child 3 times and their ability to move and catch the ball will be analysed. Each skill will be demonstrated once to the children prior to participation, no further guidance or coaching instructions will be given to allow us to assess their current technique/mastery of each skill. Once all of the skills have been completed, a cool down will be carried out by the PE specialist to reduce the risk of muscle soreness and discomfort. Each of the skills recorded will then be analysed in accordance to Move It Groove It NSW (2000) performance criteria, where each skill will be rated on a scale of 0-5/6; 0 considered being 'poor mastery' and 5/6 considered being 'mastery.' All participants will be provided with a step count pedometer and habitual physical activity levels will be measured over a four day period, consisting of two weekdays and weekend days. The children's parents will be asked to complete the form, by noting down how many steps their child has taken by bedtime, on each of the 4 days. Statistical analysis using SPSS PAW 17.0 will be used to statistically analyse the data.
What research instrument(s), validated scales or methods will be used to collect data? Please see previous section
If you are using an externally validated research instrument, technique or research method, please specify.
If you are not using an externally validated scale or research method, please attach a copy of the research instrument you will use to collect data. For example, a measurement scale, questionnaire, interview schedule, observation protocol for ethnographic work or, in the case of unstructured data collection, a topic list.

6 Confidentiality, security and retention of research data

Questions	Yes	No
Are there any reasons why you cannot guarantee the full security and confidentiality of any personal or confidential data collected for the project?		x
Is there a significant possibility that any of your participants, or people associated with them, could be directly or indirectly identified in the outputs from this project?		x
Is there a significant possibility that confidential information could be traced back to a specific organisation or agency as a result of the way you write up the results of the project?		x
Will any members of the project team retain any personal or confidential data at the end of the project, other than in fully anonymised form?		x
Will you or any member of the team intend to make use of any confidential information, knowledge, trade secrets obtained for any other purpose than this research project?		x

If you answered **No** to **all** of these questions:

- Explain how you will ensure the confidentiality and security of your research data, both during and after the project.

Data collected during the study will be kept strictly confidential, only the researcher (Luke Carl Baker), supervisor (Dr. Sam Birch) and students helping with analysis (supervised) will have access to any data collected over the course of the investigation. During the study, numbers will be allocated for each child, and names will not be used in consideration of the Data Protection Act (1988) and the BASES code of conduct.

Once data is analysed codes/numbers will still be used and names will not be disclosed. Coventry University Rules will be followed strictly, and disclosure of data to a third party is prohibited. All data and videos collected will be safely locked away in filing cabinets with the project supervisor (Dr Sam Dawson).

These will be disposed of in confidential waste by the project supervisor once the analysis has been completed.

If you answered **Yes** to **any** of these questions:

- Explain the reasons why it is essential to breach normal research protocol regarding confidentiality, security and retention of research data.

7 Informed consent

Questions	Yes	No
Will all participants be fully informed why the project is being conducted and what their participation will involve and will this information be given before the project begins?	x	
Will every participant be asked to give written consent to participating in the project before it begins?	x	
Will all participants be fully informed about what data will be collected and what will be done with these data during and after the project?	x	
Will explicit consent be sought for audio, video or photographic recording of participants?	x	
Will every participant understand what rights they have not to take part, and/or to withdraw themselves and their data from the project if they do take part?	x	
Will every participant understand that they do not need to give you reasons for deciding not to take part or to withdraw themselves and their data from the project and that there will be no repercussions as a result?	x	
If the project involves deceiving or covert observation of participants, will you debrief them at the earliest possible opportunity?	x	

If you answered **Yes** to **all** these questions:

- Explain briefly how you will implement the informed consent scheme described in your answers.
- Attach copies of your participant information leaflet, informed consent form and participant debriefing leaflet (if required) as evidence of your plans.

Informed consent forms will be issued to the parent or guardian of subject prior to the study, as we are working with a vulnerable group (under 18 years of age). The consent forms will outline and explain the investigation procedures and how the study will be carried out (methods etc). The parent/guardian will be asked to give details of specific conditions/injuries that may affect their child's participation in the study. The parent/guardian will be asked to sign the form to state they understand the risks associated with the study and threat they allow their son/daughter to participate. All children and parents are free to refuse to take part and withdraw their consent at any time during the investigation. Subjects will not be forced to participate in the study against their own will or their parents will. The class teacher cannot give consent for the children to participate; this must come from the parents.

There will not be any financial inducements offered for participation in the project, yet it will give the subjects the opportunity to learn fundamental skills and build confidence in these skills.

It is hoped that is will be a fully enjoyable experience for the children and they will get the opportunity to use new equipment, and practice skills which will hopefully increase sport/exercise participation in the future.

If you answered **No** to **any** of these questions:

- Explain why it is essential for the project to be conducted in a way that will not allow all participants the opportunity to exercise fully-informed consent.
- Explain how you propose to address the ethical issues arising from the absence of transparency.
- Attach copies of your participant information sheet and consent form as evidence of your plans.

8 Risk of harm

Questions	**Yes**	**No**
Is there any significant risk that your project may lead to physical harm to participants or researchers?		x
Is there any significant risk that your project may lead to psychological or emotional distress to participants or researchers?		x
Is there any significant risk that your project may place the participants or the researchers in potentially dangerous situations or environments?		x
Is there any significant risk that your project may result in harm to the reputation of participants, researchers, their employers, or other persons or organisations?		x

If you answered **Yes** to **any** of these questions:

- Explain the nature of the risks involved and why it is necessary for the participants or researchers to be exposed to such risks.
- Explain how you propose to assess, manage and mitigate any risks to participants or researchers.
- Explain the arrangements by which you will ensure that participants understand and consent to these risks.
- Explain the arrangements you will make to refer participants or researchers to sources of help if they are seriously distressed or harmed as a result of taking part in the project.
- Explain the arrangements for recording and reporting any adverse consequences of the research.

It is likely that all of the children will have performed all of the skills/ exercises before, however, as with all types of exercise there is risk of tripping over, sprains, muscle soreness etc if the exercise is not familiar. A thorough warm-up will be conducted prior to the exercise tests to prevent this occurring but the parents and children will be made aware of this situation. A risk assessment of the sports hall will also be carried out prior to testing.

9 Risk of disclosure of harm or potential harm

Questions	Yes	No
Is there a significant risk that the project will lead participants to disclose evidence of previous criminal offences or their intention to commit criminal offences?		x
Is there a significant risk that the project will lead participants to disclose evidence that children or vulnerable adults have or are being harmed or are at risk of harm?		x
Is there a significant risk that the project will lead participants to disclose evidence of serious risk of other types of harm?		x

If you answered **Yes** to **any** of these questions:

- Explain why it is necessary to take the risks of potential or actual disclosure.
- Explain what actions you would take if such disclosures were to occur.
- Explain what advice you will take and from whom before taking these actions.
- Explain what information you will give participants about the possible consequences of disclosing information about criminal or serious risk of harm.

10 Payment of participants

Questions	Yes	No
Do you intend to offer participants cash payments or any other kind of inducements or compensation for taking part in your project?		x
Is there any significant possibility that such inducements will cause participants to consent to risks that they might not otherwise find acceptable?		x
Is there any significant possibility that the prospect of payment or other rewards will systematically skew the data provided by participants in any way?		x
Will you inform participants that accepting compensation or inducements does not negate their right to withdraw from the project?		x

If you answered **Yes** to **any** of these questions:

- Explain the nature of the inducements or the amount of the payments that will be offered.
- Explain the reasons why it is necessary to offer payments.
- Explain why you consider it is ethically and methodologically acceptable to offer payments.

11 Capacity to give informed consent

Questions	Yes	No
Do you propose to recruit any participants who are under 18 years of age?	x	
Do you propose to recruit any participants who have learning difficulties?		x
Do you propose to recruit any participants with communication difficulties including difficulties arising from limited facility with the English language?		x
Do you propose to recruit any participants who are very elderly or infirm?		x
Do you propose to recruit any participants with mental health problems or other medical problems that may impair their cognitive abilities?		x
Do you propose to recruit any participants who may not be able to understand fully the nature of the research and the implications for them of participating in it?		x

If you answered **Yes** to **only the last two** questions, proceed to **Section 16** and then apply using the online NHS Research Ethics Committee approval form.

If you answered **Yes** to **any** of the **first four** questions:

- Explain how you will ensure that the interests and wishes of participants are understood and taken in to account.
- Explain how in the case of children the wishes of their parents or guardians are understood and taken into account.

12 Is participation genuinely voluntary?

Questions	Yes	No
Are you proposing to recruit participants who are employees or students of Coventry University or of organisation(s) that are formal collaborators in the project?		x
Are you proposing to recruit participants who are employees recruited through other business, voluntary or public sector organisations?		x
Are you proposing to recruit participants who are pupils or students recruited through educational institutions?	x	
Are you proposing to recruit participants who are clients recruited through voluntary or public services?		x
Are you proposing to recruit participants who are living in residential communities or institutions?		x
Are you proposing to recruit participants who are in-patients in a hospital or other medical establishment?		x
Are you proposing to recruit participants who are recruited by virtue of their employment in the police or armed services?		x
Are you proposing to recruit participants who are being detained or sanctioned in the criminal justice system?		x
Are you proposing to recruit participants who may not feel empowered to refuse to participate in the research?		x

If you answered **Yes** to **any** of these questions:

- Explain how your participants will be recruited.
- Explain what steps you will take to ensure that participation in this project is genuinely voluntary.

Following Coventry University Ethics Committee approval, informed consent (see attached) will be issued to six local primary schools in the Coventry Region. The funder of this project has contacted the schools already and the project has been agreed by Head teachers at each school. The desired subject number recruited will be 600 children ranging from year's 1-6 respectively. Parents will be asked to sign and return the forms to their child's class teacher. Only children with signed consent forms from the parents and who give assent themselves to take part will be recruited for the study. Under no circumstances will a child be made to participate in the study if they do not wish to, even if their parents have signed to say that they can.

13 On-line and Internet Research

Questions	Yes	No
Will any part of your project involve collecting data by means of electronic media such as the Internet or e-mail?		x
Is there a significant possibility that the project will encourage children under 18 to access inappropriate websites or correspond with people who pose risk of harm?		x
Is there a significant possibility that the project will cause participants to become distressed or harmed in ways that may not be apparent to the researcher(s)?		x
Will the project incur risks of breaching participant confidentiality and anonymity that arise specifically from the use of electronic media?		x

If you answered **Yes** to **any** of these questions:

- Explain why you propose to use electronic media.
- Explain how you propose to address the risks associated with online/internet research.
- Ensure that your answers to the previous sections address any issues related to online research.

14 Other ethical risks

Question	Yes	No
Are there any other ethical issues or risks of harm raised by your project that have not been covered by previous questions?		x

If you answered **Yes** to **this** question:

- Explain the nature of these ethical issues and risks.
- Explain why you need to incur these ethical issues and risks.
- Explain how you propose to deal with these ethical issues and risks.

15 Research with non-human vertebrates[2]

Questions	Yes	No
Will any part of your project involve the study of animals in their natural habitat?		x
Will your project involve the recording of behaviour of animals in a non-natural setting that is outside the control of the researcher?		x
Will your field work involve any direct intervention other than recording the behaviour of the animals available for observation?		x
Is the species you plan to research endangered, locally rare or part of a sensitive ecosystem protected by legislation?		x
Is there any significant possibility that the welfare of the target species or those sharing the local environment/habitat will be detrimentally affected?		x
Is there any significant possibility that the habitat of the animals will be damaged by the project such that their health and survival will be endangered?		x
Will project work involve intervention work in a non-natural setting in relation to invertebrate species other than *Octopus vulgaris*?		x

If you answered **Yes** to **any** of these questions:

- Explain the reasons for conducting the project in the way you propose and the academic benefits that will flow from it.
- Explain the nature of the risks to the animals and their habitat.
- Explain how you propose to assess, manage and mitigate these risks.

[2] The Animals Scientific Procedures Act (1986) was amended in 1993. As a result the common octopus (*Octopus vulgaris*), as an invertebrate species, is now covered by the act.

16 Principal Investigator Certification

Please ensure that you:

- Tick all the boxes below that are relevant to your project and sign this checklist.
- Students must get their Director of Studies to countersign this declaration.

I believe that this project **does not require research ethics peer review**. I have completed Sections 1-2 and kept a copy for my own records. I realise I may be asked to provide a copy of this checklist at any time.	
I request that this project is **exempt from internal research ethics peer review** because it will be, or has been, reviewed by an external research ethics committee. I have completed Sections 1-4 and have attached/will attach a copy of the favourable ethical review issued by the external research ethics committee. Please give the name of the external research ethics committee here: Send to ethics@coventry.ac.uk	
I **request an ethics peer review** and confirm that I have answered all relevant questions in this checklist honestly. Send to ethics@coventry.ac.uk	x
I confirm that I will carry out the project in the ways described in this checklist. I will immediately suspend research and request new ethical approval if the project subsequently changes the information I have given in this checklist.	x
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the Code of Research Ethics issued by the relevant national learned society.	x
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the University's Research Ethics, Governance and Integrity Framework.	x

Signatures

If you submit this checklist and any attachments by e-mail, you should type your name in the signature space. An email attachment sent from your University inbox will be assumed to have been signed electronically.

Principal Investigator

Signed: L.Baker

Date: Nov 2010

Students submitting this checklist by email must append to it an email from their Director of Studies confirming that they are prepared to make the declaration above and to countersign this checklist. This email will be taken as an electronic countersignature.

Student's Director of Studies

Countersigned: S.Birch

Date: Dec 2010

I have read this checklist and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Note: This checklist is based on an ethics approval form produce by Research Office of the College of Business, Law and Social Sciences at Nottingham Trent University. Copyright is acknowledged.

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Initial assessment

Date checklist initially received:	DD/MM/YYYY	
1. Ethical review required	Yes	No
2. CRB check required	Yes	No
Submitted to an external research ethics committee		
3. External research ethics committee (Name)	Yes	No
4. Copy of external ethical clearance received	DD/MM/YYYY	
Ethics Panel Review		
5. Date sent to reviewer 1 (Name)	DD/MM/YYYY	
6. Date sent to reviewer 2 (Name)	DD/MM/YYYY	
Original Decision (Consultation with Chair UARC/Chair RDSC)		
7. Approve	Yes	No
8. Approve with conditions (specify)	Yes	No
9. Resubmission	Yes	No
10. Reject	Yes	No
11. Date of letter to applicant	DD/MM/YYYY	
Resubmission		
12. Date of receipt of resubmission:	DD/MM/YYYY	
13. Date sent to reviewer 1 (Name)	DD/MM/YYYY	
14. Date sent to reviewer 2 (Name)	DD/MM/YYYY	
Final decision recorded (Consultation with Chair UARC/Chair RDSC)		
15. Approve	Yes	No
16. Approve with conditions (specify)	Yes	No
17. Reject	Yes	No
18. Date of letter to applicant	DD/MM/YYYY	

Signature .... (Chair of UARC/Chair RDSC)

Date ....